the OIL AND GAS JOURNAL

APRIL 1, 1957

Trends in Oil Exploration

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- Search for Strat Traps
- Fracturing
- Reappraisal of Structures

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1926

1930

1957

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JOURNAL News Letter

April 1, 1957
Tulsa, Oklahoma

Time is killing the gas bill:

Feeling is growing in Washington that unless something gets rolling for a bill in the next 10 days, you can kiss the issue off this year. And most feel any bill is doomed.

Eisenhower's news-conference statement last week doesn't measure up to a hard-hitting move needed to break the lethargy in Congress. He said a bill lifting federal price controls from independent natural-gas producers is essential. But the President doesn't know if the administration will submit such a bill to Congress.

Too many strikes are piling up against the bill. At first it was reported from inside the cabinet that Attorney General Brownell was a restraining influence. Now word is that industry proposals for a bill have been reviewed and approved with some changes by Brownell. But it has been impossible to find a top member of Congress who will sponsor the measure. Democratic leaders want no part of a gas bill fight unless the measure has strong White House endorsement. It's also getting harder to convince other congressmen that controls are disastrous to the industry. They point to record-breaking gas discoveries made last year despite present controls.

There's also more talk in WASHINGTON about increasing the tariff on crude oil imported into this country.

Several straws in the wind: Senators sitting in at the O'Mahoney hearings have remarked pointedly at the lack of revenue to the U. S. from foreign operations of oil companies. Some lawmakers say they think these oil companies should ante up a little more in the way of taxes. Higher oil tariffs would fit this bill.

Such a move even might find support in the oil industry, thanks to the rift between importers and domestic producers. There's evidence the domestic segment of the industry will view high tariffs as a device to control imports. These people reason that efforts to limit imports by voluntary quotas are failing. The only answer is a sufficiently high tariff wall.

It's touch and go whether the oil-tariff issue ever will emerge from the talk-stage this session. But mark it down as a comer next year. The Trade

Agreements Act will be up again then for consideration, and the entire question can be reopened.

The A.P.I. is still hot on the idea of an all-industry spokesman. Industry officials are on the lookout for the right man. After Ed Gossett of Dallas turned down the job, the A.P.I. executive committee turned to Frank Porter, the A.P.I. president. He was asked to consider moving into the spot--at least temporarily. But Porter doesn't like Washington. Best bet at present: The executive committee won't insist and Porter won't move to Washington.

The name of J. Ed Warren, former Texas independent operator and now vice president of New York's First National City Bank, was being talked for the job. But only a few days ago he was promoted to a senior vice presidency in his bank. Oil men are now wondering if that was the bank's way of removing Warren from consideration.

San Francisco's earthquakes apparently did very little damage to oil properties. Companies report wells, pipelines, and plants were not seriously affected. It was a lucky break because in some past tremors the oil industry have counted a heavy toll in ruined wells and pipelines.

Diplomatic sources are putting a third PIPELINE in the Middle East down as a sure thing. It's one of the concrete results emerging from the Eisenhower-Macmillan talks at Bermuda. (P. 95)

Details have not been firmed up on such things as route, size, capacity, cost of the line. But this much is becoming known: The U. S. and Britain will solidly back the deal. They'll support the line financially if necessary and give it a protective coating of international treaty.

Next move will come when a special committee now studying all aspects of the line makes its report. Technicians on the committee come from eight oil companies operating in the Middle East. The strategy, naturally, is to make the West less and less dependent on the Suez Canal.

One of the biggest crude pipeline projects of the year gets underway in May. It's the 20-in. Tecumseh line running 200 miles from East Chicago to Cygnet, Ohio. Builders are Sinclair Pipe Line, Ashland Oil & Refining, and Pure Oil, with Sinclair operating the project. The line will feed carriers serving markets in Ohio, Michigan, and New York. Construction contracts will be let the middle of this month. Pipe deliveries will start the last of April and continue through May.

Great Lakes Pipe Line is extending its products system into new markets of Eau Claire and Superior, Wis. These extensions plus increased capacity into Chicago highlight a $15 million expansion program for the 5,000-mile system ranging from Tulsa through the Midwest. Octanes also are rising on the line. Only last week refiners who ship on the line voted to hike octanes of gasoline by 1 number for each grade.

Trend of major gas pipeline companies moving into exploration and production is being stepped up. This is exemplified by Tennessee Gas Transmission's 1957 budget. It calls for $25 million expenditure in drilling for oil and gas. This compares with $16 million in 1956 and $10 million in 1955.

T. G. T. will drill or participate in about 500 wells this year, including some 100 wildcats. The company drilled only 323 wells and 76 wildcats last year.

Offshore operators are trying to figure ways to sidestep big costs of marine pipelines--3 to 4-1/2 times higher than onshore lines. One method being talked: Man-made islands with tanker loading and storage facilities. Small tankers could load from the centralized platforms and deliver crude directly to refining areas. Only small-diameter lines would be required between wells and island. Plan may be limited by its disadvantages: Higher operating costs than pipelines and vulnerability to stormy weather.

Where are the biggest EXPLORATION payoffs these days?

A new study shows they're in Louisiana--southern areas and offshore --and the Rocky Mountains. They are the only two areas consistently beating the national averages for finding new reserves. Texas is just below the average followed by Oklahoma, Kansas, and Illinois. (P. 105).

Here's a first-quarter report from the hot spots:

...Rockies--Paradox basin of Four Corners area is living up to its prediction as 1957's top oil province. Eight new oil and gas discoveries have been made so far this year (P. 117). Williston basin has recorded two of its most significant discoveries this year. Now report is: Look for some real wildcat excitement in both eastern Montana and North Dakota when warm weather comes (P. 118).

...Louisiana offshore--seven new fields have been opened in last 3 months. The year promises sharp stepup in drilling activity (P. 142).

This week's special exploration issue of The Journal also pinpoints new possibilities in California, western Kansas, the Illinois-Indiana-Kentucky basin, and West Texas.

Explorers will be interested in the wildcat scoreboard for 1956. It's being given this week at the St. Louis gathering of A. A. P. G. The tally: 16,173 exploratory wells drilled, up 1,236 over 1955. Technical advice was used on 84 per cent. The payoff: 19.79 per cent of the wells were successful. One in nine found a new field. And one in 44 found million-barrel reserves. Technical oil finders were three times more successful than explorers using hit-and-miss methods (P. 100).

The world's longest oil field is 12 miles longer. Aramco has extended the 140-mile long Ghawar field in Saudi Arabia to the north. Nearest production to new well is in the Ain Dar area of the huge Ghawar trend (P. 95).

American oil men aren't buying any of those reports from Rome that the Italian-owned company has completed deal to develop Iran's Qum oil strike. The reports say Italy's E. N. I. and National Iranian Oil will form third company to exploit the field and build a 1,000-mile pipeline to Mediterranean. Americans see these strikes against such a deal: Iran's shah is dead set against any company owned by foreign government getting into Iranian oil. A big piece of money would be needed, and the Italian company has trouble getting cash to do big business in own nation.

California's legislature has handed offshore explorers another setback. The State Assembly has passed a bill forcing companies to give all their seismic and core-hole data involving state-owned tidelands to State Lands Commission.

Free-world oil PRODUCTION is edging nearer pre-Suez levels. January production reached 14,770,500 bbl. daily. That's up 403,800 bbl. daily over December and within 2.9 per cent of October's 15,217,800 bbl. daily (P. 96).

Caltex is quietly pushing big expansion to boost its production in Central Sumatra where Minas field already is good for 125,000 bbl. daily. It plans full-scale development of two more fields, a 30-in. pipeline 30 miles to new deep-water loading port, and a complete new terminal at Dumai (P. 98).

Look for offshore companies to start exploring possibility of underwater completions. Big spur is money. This is shown by Shell's recent experience in installing a wellhead platform over its recent discovery in 97 ft. water off Louisiana. Cost of one-well jacket hit $250,000.

DRILLERS are still concerned by statistics on active rotary rigs. They hit lowest point of the month last week. Only 2,396 rigs were busy, 54 fewer than the week before, which was the high mark for March. Last year at this time there were 2,643 rotaries active.

Nice payoff is in prospect for Tidewater and associates. Operators have finally tested high-pressure gas sand at 1 H. Thibodeaux in Acadia Parish, La. They estimate 100 ft. of net pay sand between 14,296 and 14,462 ft.

REFINERS now have a better idea what they're up against in the future. From speakers and corridor talk at San Antonio session of Western Petroleum Refiners came these predictions on:

...Gasolines---107-octane premium and 98-octane regular by 1965. Weighted-average research octane then will be 101 for all U.S. gasolines. It will cost average refiner 60 cents a barrel more than he's spending now to make these fuels. Refiners will make the big jump by alkylation and isomerization processing backed up by cat reforming and extraction (P. 73).

...Auto engines--the piston engine will be pushed to 12:1 and possibly 12-1/2:1 compression ratio in next 4 years. Prospects for gas turbine or free-piston engines in autos aren't too good.

Threat of having to change composition of motor fuels is being faced by refiners serving the Los Angeles smog area. That issue was debated hard and hot at air-pollution gathering last week. Auto exhausts are blamed for half of the hydrocarbons released daily into Los Angeles atmosphere and for 98 per cent of dangerous oxides of nitrogen. Other approaches to problem besides changing fuels: Afterburners for autos to eliminate unburned fuel... And fuel cut-off devices to regulate flow of fuel into engine while car is slowing down, a critical period for smog making.

Another new development using

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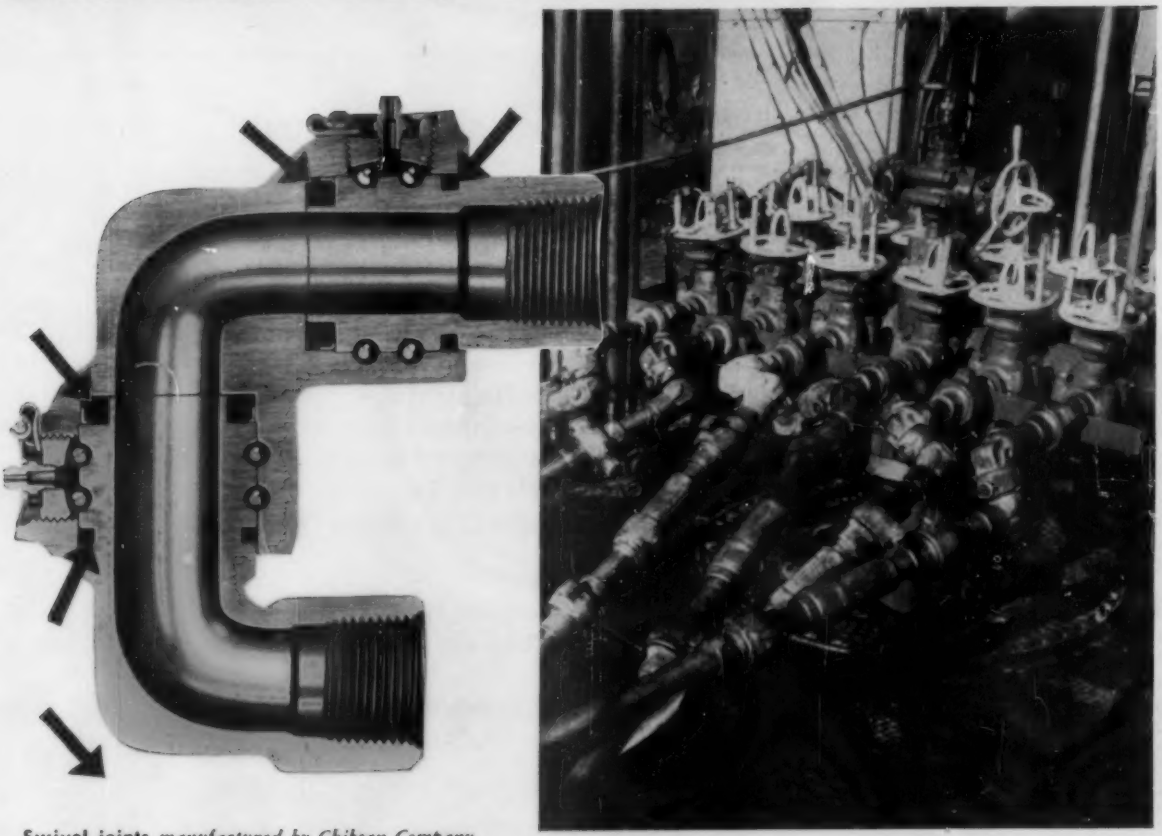

Swivel joints *manufactured by Chiksan Company, Brea, California are packed with Hycar to keep them pressure-tight and free turning. Hycar packing molded by Plastic and Rubber Products Co., Los Angeles, Calif.*

This manifold *of Hycar-packed Chiksan swivel joints handles high pressure pumping of oil emulsion laden with sand to give formation fracturing treatment on a well.*

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APRIL 1, 1957 • VOLUME 55 • NUMBER 13

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The Oil and Gas Journal, Published Mondays, copyright 1957, by The Petroleum Publishing Co. Entered as second-class matter September 1, 1910, at post office at Tulsa, Okla., under act of March 3, 1879. United States and foreign rates to the petroleum industry, 1 year $4, 2 years $7, 3 years $8.

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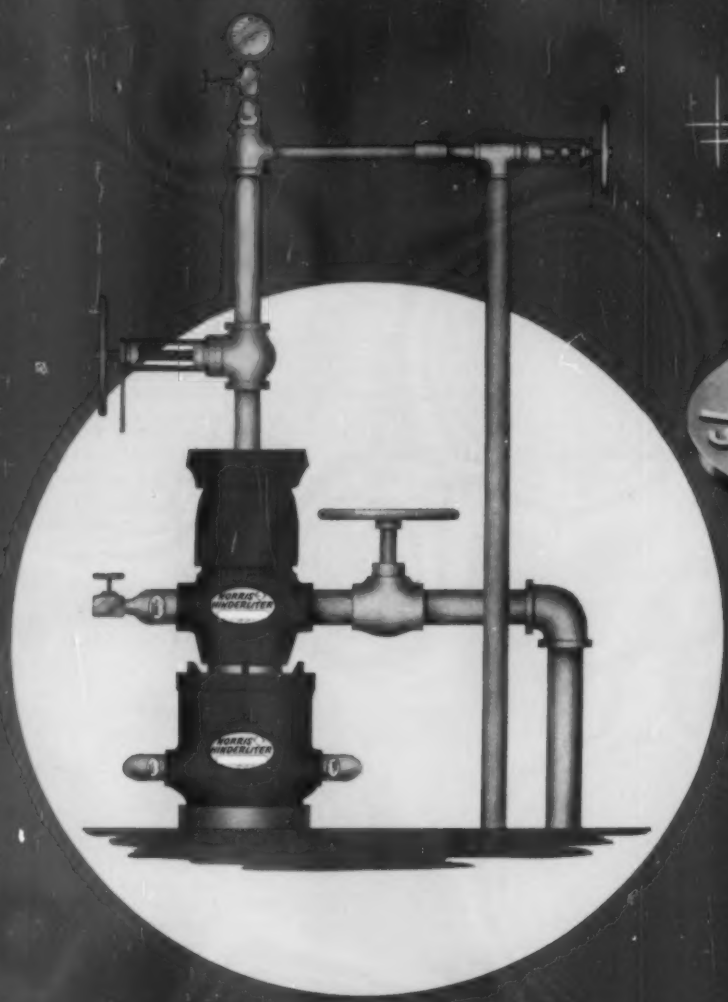

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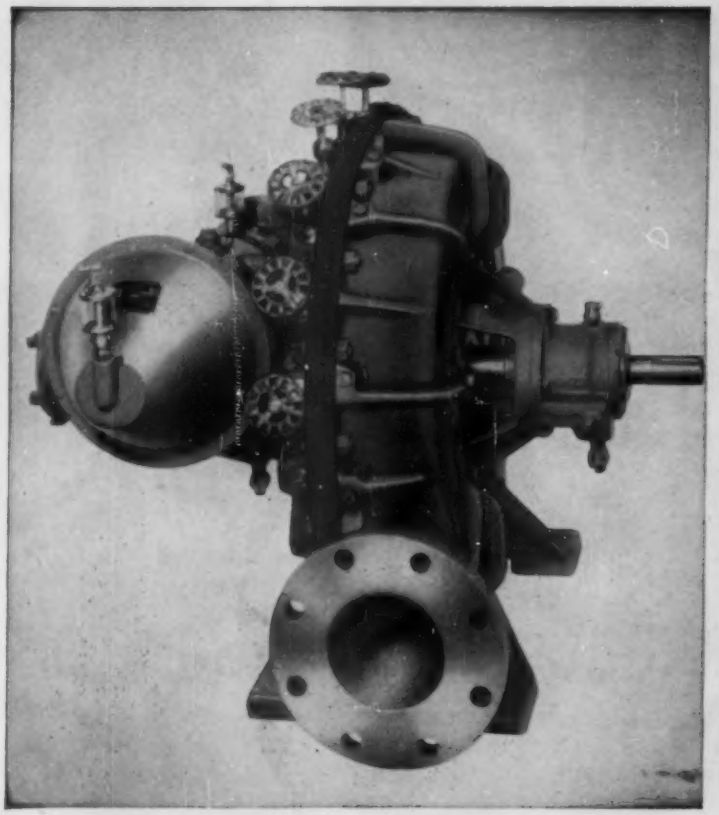

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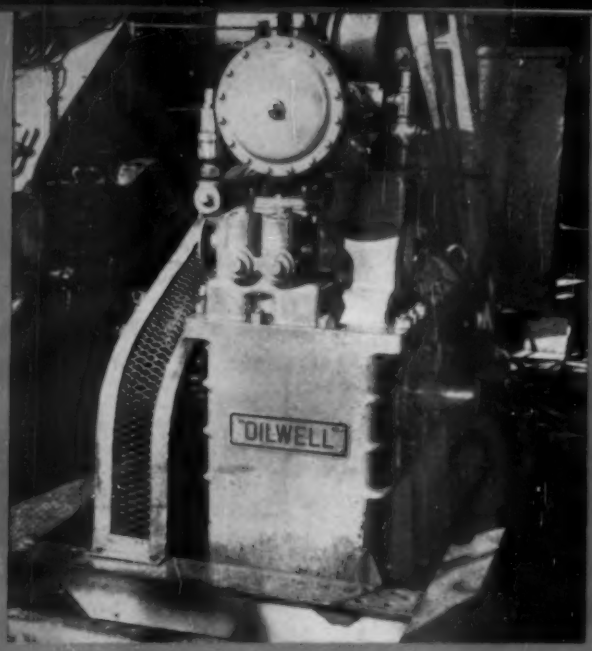

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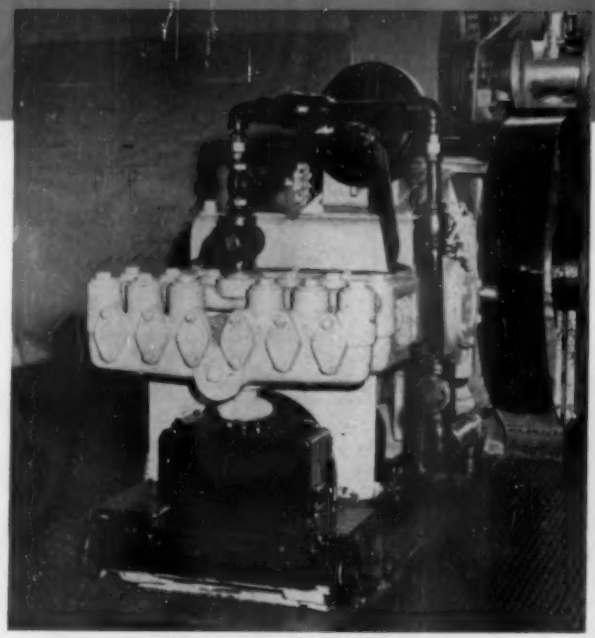

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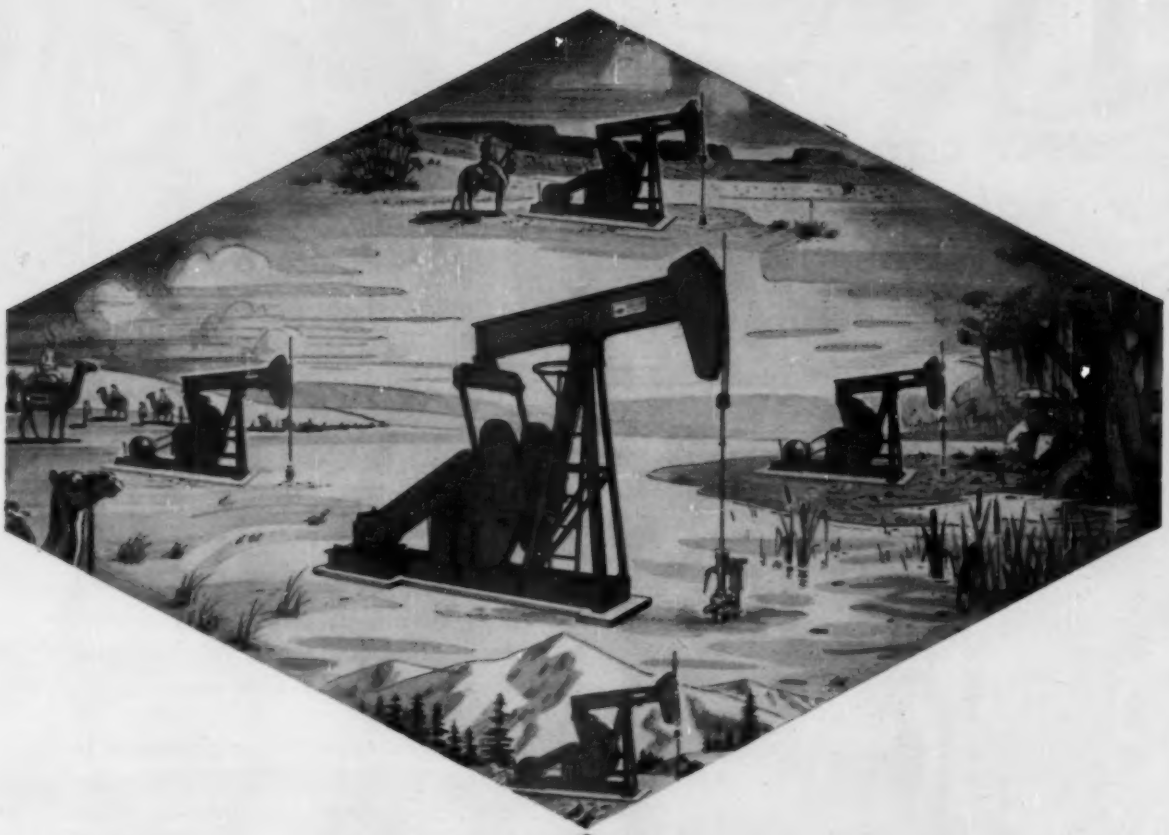

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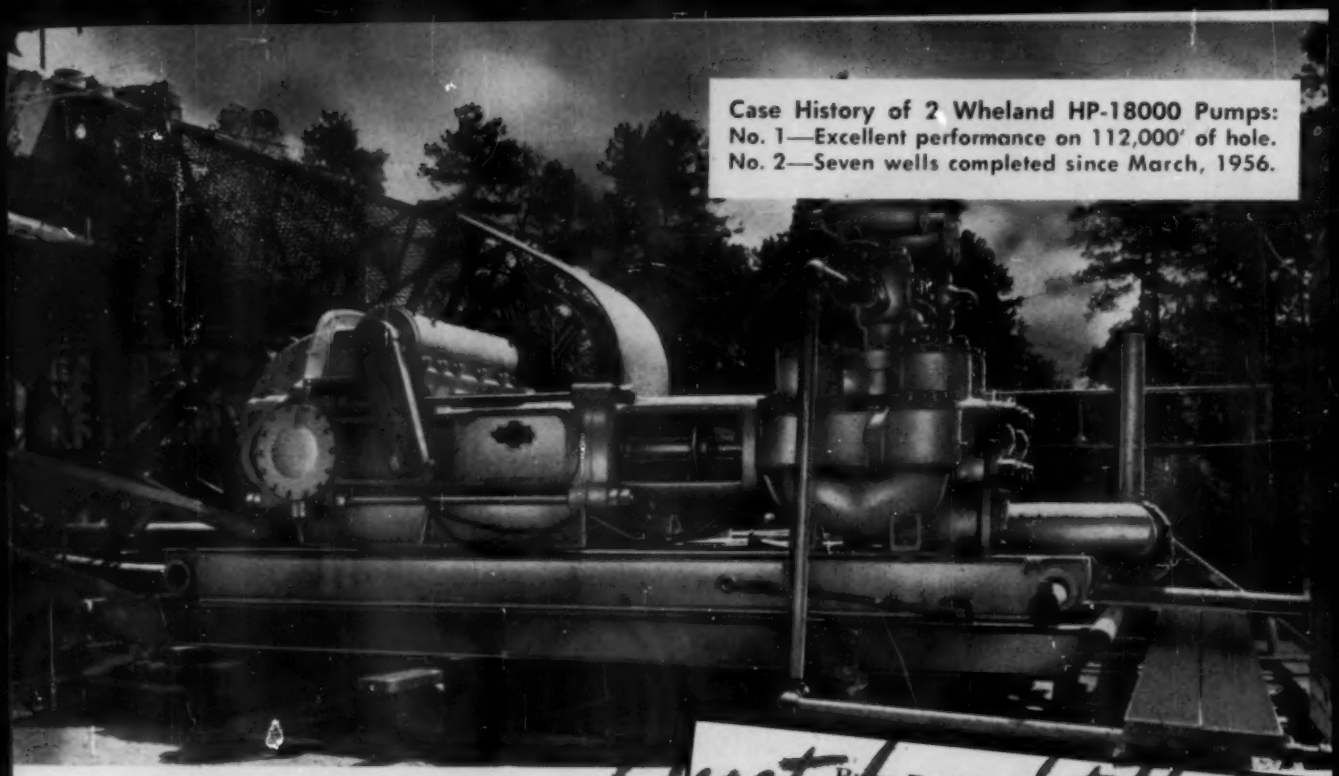

Case History of 2 Wheland HP-18000 Pumps:
No. 1—Excellent performance on 112,000' of hole.
No. 2—Seven wells completed since March, 1956.

Here is the second Wheland HP-18000 Pump purchased by Bilbo-Redding, shown on location at Cleveland, Texas. Their first pump's record was so good, this one was put in service 11 months later.

PERFORMANCE SOLD THE SECOND PUMP

"... exceptional performance ... operated with ease at all pressures within their ranges ... required little maintenance."

WHELAND HP-18000 DUPLEX SLUSH PUMP

7¾" x 18", 750 HP Nominal Input at 60 RPM. Discharge Pressure with 7¾" liner, 1322 PSI; with 5½" liner, 2700 PSI.

BULLETIN ON REQUEST

Just bought their 3rd HP-18000!

Bilbo-Redding Drilling Co., Inc.
Cleveland, Texas

1956

Mr. [redacted] Street, President
The Wheland Company
Chattanooga, Tennessee

Dear Mr. Street:

The Wheland HP-18000 750 HP Pump we bought from you in May of 1955 went immediately into service in the Texas Gulf Coast and has given excellent performance on 112,000 feet of hole.

This pump's record was so good that we put a second one into service early in March of this year. We have already completed 7 wells in the Gulf Coast area using the second pump.

Both of these pumps have given exceptional performance, have operated with ease at all pressures within their ranges and have required little maintenance.

Sincerely yours,

BILBO-REDDING DRILLING CO., INC.

T. P. Bilbo

T. P. Bilbo, Vice-President

TPB:da

WHELAND ROTARY DRILLING MACHINERY

THE WHELAND COMPANY

CHATTANOOGA, TENNESSEE, U.S.A.

DRAW WORKS • SLUSH PUMPS • ROTARIES
CROWN BLOCKS • TRAVELING BLOCKS • SWIVELS

DOMESTIC DISTRIBUTORS: INDUSTRIAL SUPPLY COMPANY, INC.—Main Office: Wichita Falls, Texas • HOUSTON OIL FIELD MATERIAL COMPANY, INC.—Main Office: Houston, Texas • JONES AND LAUGHLIN STEEL CORPORATION, SUPPLY DIVISION—Main Office: Drawer 2481, Tulsa 2, Oklahoma.

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Guiberson
Casing Swab
with "GW" Cups

FLEXIBILITY

that means every-drop casing swabbing!

GUIBERSON "GW" CUPS

**hug casing wall—
automatic seal,
controlled pipe contact**

- Unequalled in rough or mixed casing strings
- Stout, flexible lip brings up every drop
- Won't down-swab or hang on casing collars
- Perfect for unloading shallow wells
- Abrasion resistant compound — takes up own wear
- Performs better — lasts longer — costs no more
- Interchangeable on the Guiberson Casing Swab

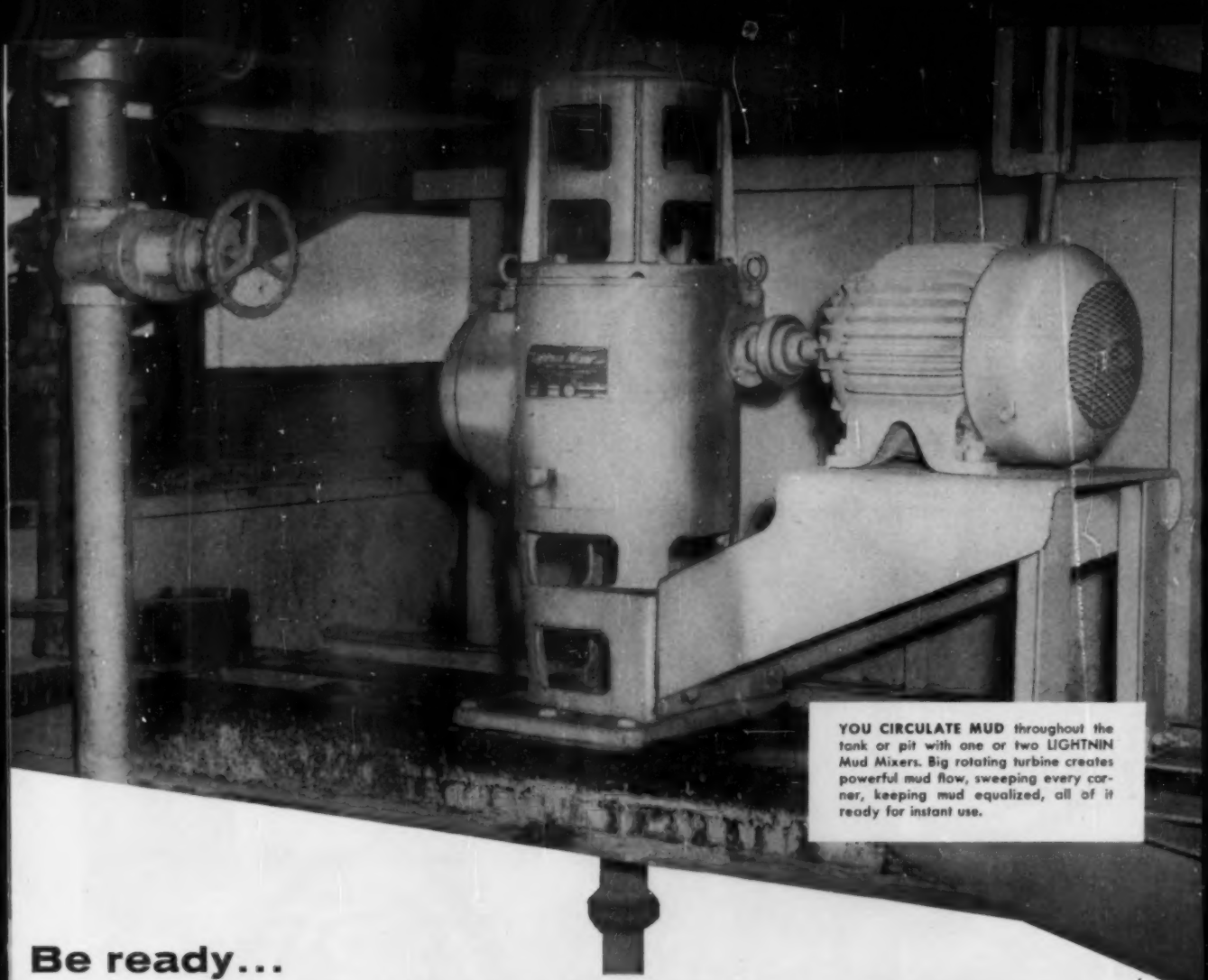
Guiberson Swab with "GW" and "K" cups offers greatest size range on the market.

Better Be Safe Than Sorry!

THE
GUIBERSON
CORPORATION

ESTABLISHED 1919
DALLAS, TEXAS
U. S. A.

Sold by
Oil Field Supply Stores
Everywhere



YOU CIRCULATE MUD throughout the tank or pit with one or two LIGHTNIN Mud Mixers. Big rotating turbine creates powerful mud flow, sweeping every corner, keeping mud equalized, all of it ready for instant use.

Be ready...

with mud you can change in seconds!

Here's how: Use this amazingly fast new way to get mud in condition—and keep it there.

On drilling tenders off the Gulf Coast—on the world's deepest holes—all up and down the oil country, drilling men are getting an *immediate* rise in mud weight when they want it.

You can, too. When you mix your mud with LIGHTNIN Mixers, you can increase the weight of every gallon of mud in the tank or pit, by the exact amount you want—*in a few seconds.*

You get *immediate dispersion* of gel additions—and fully uniform viscosity in minutes.

When you need heavier, thicker mud, *it's there*—ready for instant use.

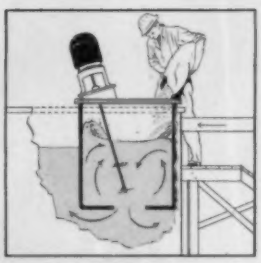
Cut maintenance, too

You gain in many other ways, too, with LIGHTNIN Mixers in your mud tanks or mud pits. You use *less* mud; put *less* demand on your pumps; spend *less* on equipment maintenance. On deep holes, you can eliminate the entire cost of a third mud pump.

You take no risk when you choose LIGHTNIN Mixers. Every LIGHTNIN is unconditionally guaranteed to do the mixing job right.

See for yourself why LIGHTNINs can give you better mud control—for less money. Ask your LIGHTNIN sales engineer (listed in Composite Catalog) to arrange a visit to a rig in your area so you can see LIGHTNINs at work.

And for quick facts on LIGHTNIN mud control, send us a postal today requesting free illustrated Bulletin B-502.



YOU FLASH-MIX weight and gel additions into the mud through a LIGHTNIN Flash Mixer. High-speed propellers break lumps and give instant dispersion of weight and gel in the incoming mud. Feed additions fast as you want—no clogging, no waiting.

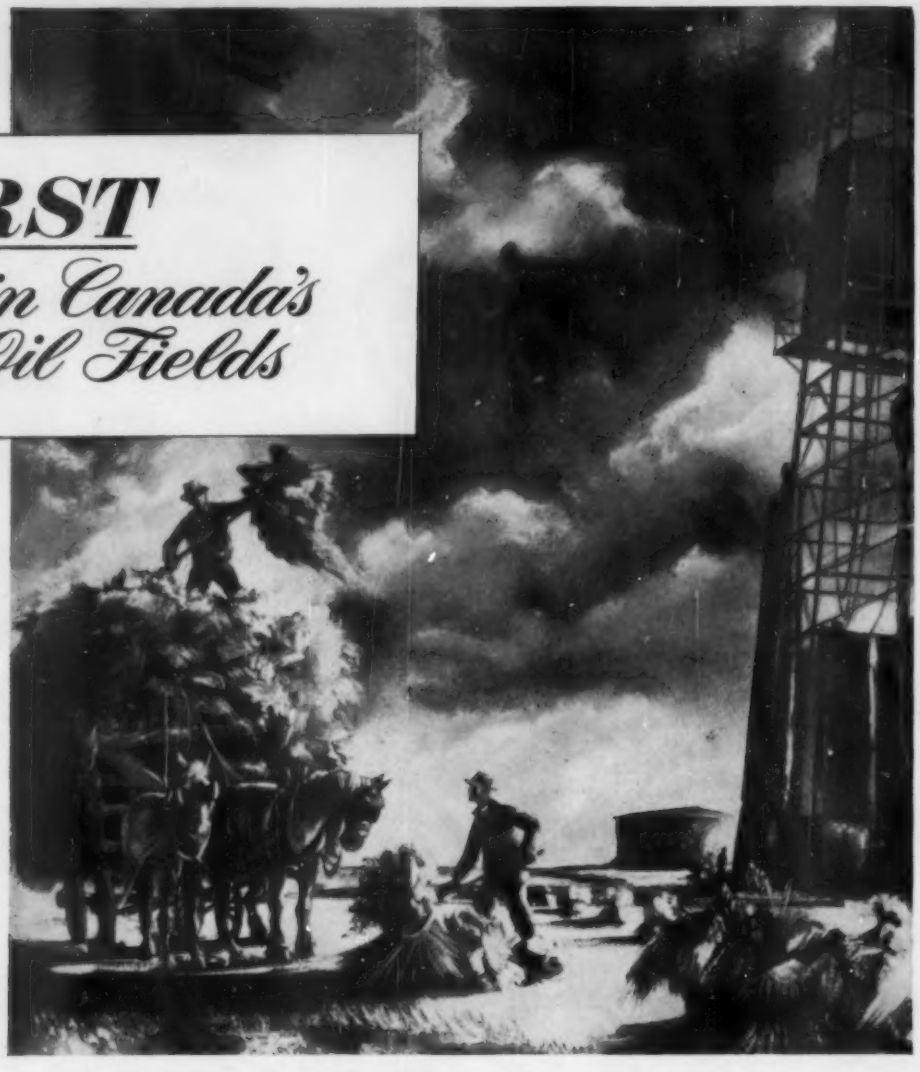
MIXING EQUIPMENT Co., Inc., 174-d Mt. Read Blvd., Rochester 11, N.Y.

In Canada: Greey Mixing Equipment Ltd., Toronto 10, Ont.

Lightnin® Mixers™

FIRST

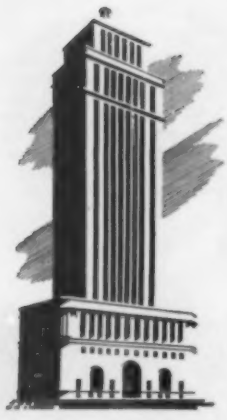
in Canada's Oil Fields



The Royal Bank of Canada, Canada's largest bank, whose clients include many of the most prominent firms in the field, offers exceptional services to the petroleum industry. Its Oil and Gas Department, manned by experienced officers in close touch with the situation, provides information, guidance and practical aid to prospective entrants.

In Alberta, Canada's oil-and-gas-rich province, Royal Bank branches number 65, including Calgary, Edmonton, Leduc, Devon, Redwater, Drayton Valley and Turner Valley. Altogether this bank operates over 300 branches in the oil and gas areas of Western Canada alone.

We do not provide information on oil securities.



The Royal Bank of Canada has just issued a new map showing Canada's oil and gas fields, existing pipelines and projected pipelines. This map is free on request to The Royal Bank of Canada, Oil and Gas Department, 411—8th Avenue West, Calgary, Alberta.

THE ROYAL BANK OF CANADA

Canada's Oil Bank

New York Agency—68 William Street, New York 5, N. Y.
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Assets exceed 3½ billion dollars

Over 875 branches in Canada, the West Indies, Central and South America. Offices in New York, London and Paris.

From Calgary to Kuwait, wherever oil men seek unlimited flexibility in handling fluids, semi-solids and gases, you will find Chiksan Swivel Joints in service. And wherever temporary piping calls for quick, make-and-break wing nut unions, chances are they're Weco Unions.

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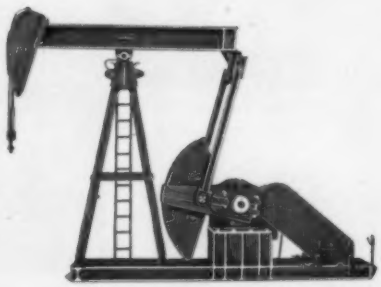
Well Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Company • Chiksan of Canada Ltd. Dept. 34

you don't have to persuade a LEGRAND

PUMPING UNIT

Unlike the mule with its obstinate temperament, the Le Grand 'L' Series Pumping Units are paragons of virtue.

There is a unit available to meet every oilwell mechanical pumping need (from 3,000 lbs. to 30,000 lbs. polished rod load and 24" to 108" stroke). Incorporating the most up-to-date design features Le Grand Pumping Units are the result of long practical experience in the Oil Fields of the World.



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HORSTED AIRPORT • ROCHESTER • KENT • ENGLAND

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It's a real slick little tool that can save you a lot of fixed capital investment - and bother - each year.

To obtain well pressure reading, insert master gauge with Connector in Gauge Valve and turn gauge 45 degrees. Gauge Valve opens automatically, exposing gauge to pressure. Remove gauge and Gauge Valve closes automatically.

HERE'S HOW IT WORKS: Instead of buying one or two pressure gauges for each Christmas tree, you buy just one master gauge *for an entire field.* Then, install these inexpensive Gauge Valves where you have been installing permanent type gauges—one on the tubing and one on the casing. Your Gauger takes the master gauge from well to well, stabs it into the Gauge Valve to obtain the pressure reading.

Only one gauge to buy.
No breakage.
No gauge repairs.
No exposure to elements.
No inaccurate pressure readings.

Ask any UNIBOLT man to demonstrate the Gauge Valve and Connector, or write:

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CONTINENTAL-EMSCO

Note how Quickly, Easily and Safely

COUNTERBALANCES MAY BE ADJUSTED BY ONE MAN WORKING AT GROUND LEVEL

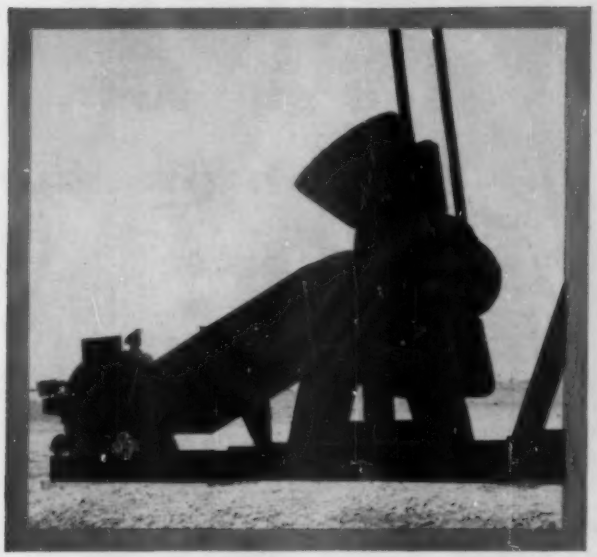
Weights at zero effect. To adjust: stop unit with lower weights about 15° off vertical. Loosen clamping bolts and weight will swing to vertical position. Tighten clamping bolts. Counterbalances may be adjusted to lead or lag the load as required.

Check and compare THESE OUTSTANDING ADVANTAGES

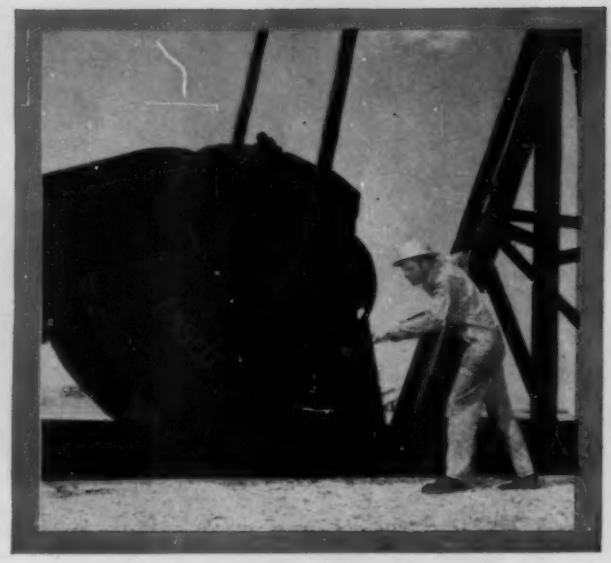
1. One man adjustable crank weights with extra weights as required.
2. One of few unit lines available with anti-friction bearings throughout.
3. Precision-cut gears (not lapped) permit partial replacement in the field when necessary. High hardness gear material stands up under hard wear.
4. Labyrinth type oil seals have no wearing parts.
5. Two sumps for oil to drop out emulsions or particles.
6. Four-legged Samson post is extremely rigid.
7. Extra rigid gear case allows precision gears to operate as designed.
8. Complete accessories, ground-level lubrication, guards, skid extensions, slide rails and modern brake.

PUMPING UNITS

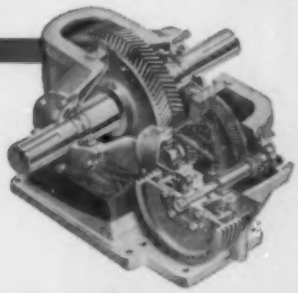
"Engineered-not just built"



Disengage service brake. The upper counterbalance weight will cause unit to swing clockwise. Stop unit when weight has swung about 15° past vertical. Loosen clamping bolts and weight will swing to vertical position. Tighten bolts.



Repeat operation until weights are swung into the desired position. When weights are pivoted as far as possible maximum counterbalance effect is obtained. Adjustment markers are provided to facilitate operation.



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Advanced design, precision manufacture and automatic lubrication at all speeds assure long and dependable operation of the pumping unit with minimum upkeep. Continental-Emsco Pumping Units are made in a wide variety of sizes for heavy, medium and light loads. Write for descriptive bulletins and other information.

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Representatives in All Principal Oil Fields of the World

PT-701

This O-C-T Dual String Wellhead Assembly has the new O-C-T Universal Tubing Head which accommodates 6 interchangeable dual string and single string tubing hangers. The foundation is an O-C-T "C-19" Casing Head.

FIRST

and still first... in high pressure wellhead equipment

This O-C-T Dual Completion Tree is only one of many economically important products pioneered by Oil Center Tool Company. It is the result of more than 15 years of continuous improvement in multiple zone completions.

Other O-C-T "Firsts:" the FIRST factory-assembled and tested Christmas Tree . . . the FIRST 10,000, the FIRST 15,000, the FIRST 30,000 pound test Christmas Trees . . . the FIRST casing head with an automatic seal . . . the FIRST and only flow control that gives advantages of both a choke and a valve . . . the FIRST universal tubing head.

When you are ready to complete your next well, turn first to the organization that was first . . . and still first . . . in meeting your present and future needs for dependable high pressure wellhead equipment. You'll be money ahead!

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ELIMINATING CONDITIONS DANGEROUS TO EMPLOYEES

As part of its never-ending effort to improve its service to employers in Texas, the Texas Employers' Insurance Association maintains one of the most complete Industrial Hygiene laboratories in the Southwest. Generally analyzing elements and compounds used by industries . . . Identifying unknown materials . . . Determining flash and fire points of hazardous substances . . . Analyzing the very air workers breathe to prevent occupational diseases . . . These are but a few of the activities carried on in this laboratory to help Texas industries discover and eliminate conditions dangerous to the health and safety of their workers.

This is one of the many services offered by the Texas Employers' Safety Engineering Division. It's only one of the methods of ensuring safer working conditions and reducing accident costs. And it is one more reason Texas Employers' is the undisputed leader in the field of Texas workmen's compensation insurance. Are you taking advantage of the SERVICE and SAVINGS offered by Texas' largest writer of this coverage?

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SEE The United States Steel Hour. Televised alternate weeks. Consult your local newspaper for time and station.

UNITED STATES STEEL

3 miles down— and still going

HOW DEEP CAN WE GO FOR OIL? Certainly, only as deep as present-day casing will permit. As yet, we haven't reached our limit. The rigs are still holding up; the drill pipe, casing and tubing are taking their daily beatings and still doing their jobs.

But what is the limit? How much stress can be withstood?

One of the answers to this problem of stress, particularly to casing, is National Tube's *Deep-Well* Casing. *Deep-Well* Casing possesses exceptional physical characteristics. It is tough, strong and has good yield strength. Minimum yield strength is 110,000 psi at .6% total strain, and average ultimate strength is 139,000 psi. And perforating tests made on National *Deep-Well* Casing have been excellent. The next time you need high strength, high collapse resistance and maximum security in a casing, use National *Deep-Well* Casing. You can rely on it to do the best job possible.

Here are some of National Tube's most notable contributions to the oil industry:

National Deoxidized Bessemer Steel Casing and Tubing—Grades H-40, J-55. Especially well-suited for oil production because of its combination of high yield strength and good ductility.

National Warm-Worked Casing—Grade N-80. An extremely high-strength casing possessing a uniformity of physical properties which give it high collapse resistance and greatly increased joint strength. It is hydrostatically tested to 80% of minimum yield strength up to a maximum of 10,000 psi.

National Deep-Well Casing. The strongest casing produced under A.P.I. specifications, to meet constantly increasing depths. Due to the severe service for which it is intended, it is hydrostatically tested to 80% minimum yield strength up to a maximum of 12,000 psi.

National (B) *Buttress-Thread.* Developed to satisfy the need for a casing joint which will safely and economically support the weight of deep-well casing. The buttress-thread joint is comparable in strength to that of the body of the pipe itself.

• • •

For further information, write to National Tube Division, United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa. Ask for Bulletin No. 15.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

NATIONAL USS SEAMLESS

DRILL PIPE . . . CASING . . . TUBING

Houston, Texas

Harvey, La.

Odessa, Texas

A New Dimension in Service to the OIL and GAS INDUSTRY

More wells and more hole than ever before—that's the prospect for the oil industry in 1957. And that's why Plastic Applicators, Inc., is making a new home among old business associates in Odessa—located in the heart of the active West Texas and New Mexico oil producing area.

More than a decade ago, the oil industry recognized the seriousness of corrosion damage to steel tubing and related equipment. Several methods of preventing or mitigating this damage were explored. Alloy steels with the necessary acid-resisting and alkali-resisting properties proved too costly. Addition of chemical inhibitors to the areas of corrosive action presented problems of injection and control at odds with the latest well completion and production practices. The third method—baked-on plastic coating of the tubing itself—provided a solution, as evidenced by its widespread use today.

To meet a steadily growing demand for its products since the company's beginnings in 1945, Plastic Applicators continues to follow a long established policy of bringing its services within the most convenient reach of its users. Third in a strategically located group of "Plasticap" plants, the Odessa facility has been modified to conform to practices of the Houston and Harvey, Louisiana units, where the "Plasticap" process has turned out millions of feet of production tubing to high standards of excellence.

Plastic Applicators, Inc., looks forward to continued friendly relations with old-time business friends and with new neighbors in the Odessa area.

Couplings are removed and pipe is thoroughly cleaned in specially designed degreasing, pickling and neutralizing tanks.

Internal sand-blasting lances complete the cleaning job down to white metal.

Inside surfaces are coated, using multiple coats and bakes, and the plastic film is given its final corrosion-resistant properties by curing in automatic ovens at carefully controlled temperatures.

Plastic Applicators, Inc.

TUBULAR GOODS INSPECTION SERVICES
BAKED-ON PLASTIC COATINGS

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President

Cordell Garner
Sales Manager

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Odessa Plant

Vernon Halverson
Superintendent
Odessa Plant

7109

Home Office and Plant: P. O. Box 7631, Houston, Texas. Phone: UN 9-2491.

Branch Offices and Plants: P. O. Box 388, Harvey, La. Phone: Fillmore 1-1636—P. O. Box 2749, Odessa, Texas. Phone: Federal 7-8862.

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CF&I SEAMLESS CASING AND TUBING

all over the Permian Basin...

Rig operators in the Permian Basin know from first-hand experience that CF&I is a desirable source for top-rate seamless oil country casing and tubing. For—ever since it opened its modern tube mill at Pueblo—CF&I has enjoyed the privilege of serving this important production and exploration area.

Oil men all over the West will tell you the same story. CF&I Seamless Casing and Tubing is top quality. CF&I controls every phase of operations required in the manufacture of its seamless casing and tubing—from the mining of its raw materials to the finished product. This step-by-step control assures a product of high quality.

Available in standard sizes from 2⅜" to 9⅝" O.D., CF&I Seamless Oil Country Casing and Tubing meets or exceeds API STD 5A specification. Ask your CF&I representative for the complete story today.

CF&I

SEAMLESS TUBULAR PRODUCTS

THE COLORADO FUEL AND IRON CORPORATION

Denver, Colorado

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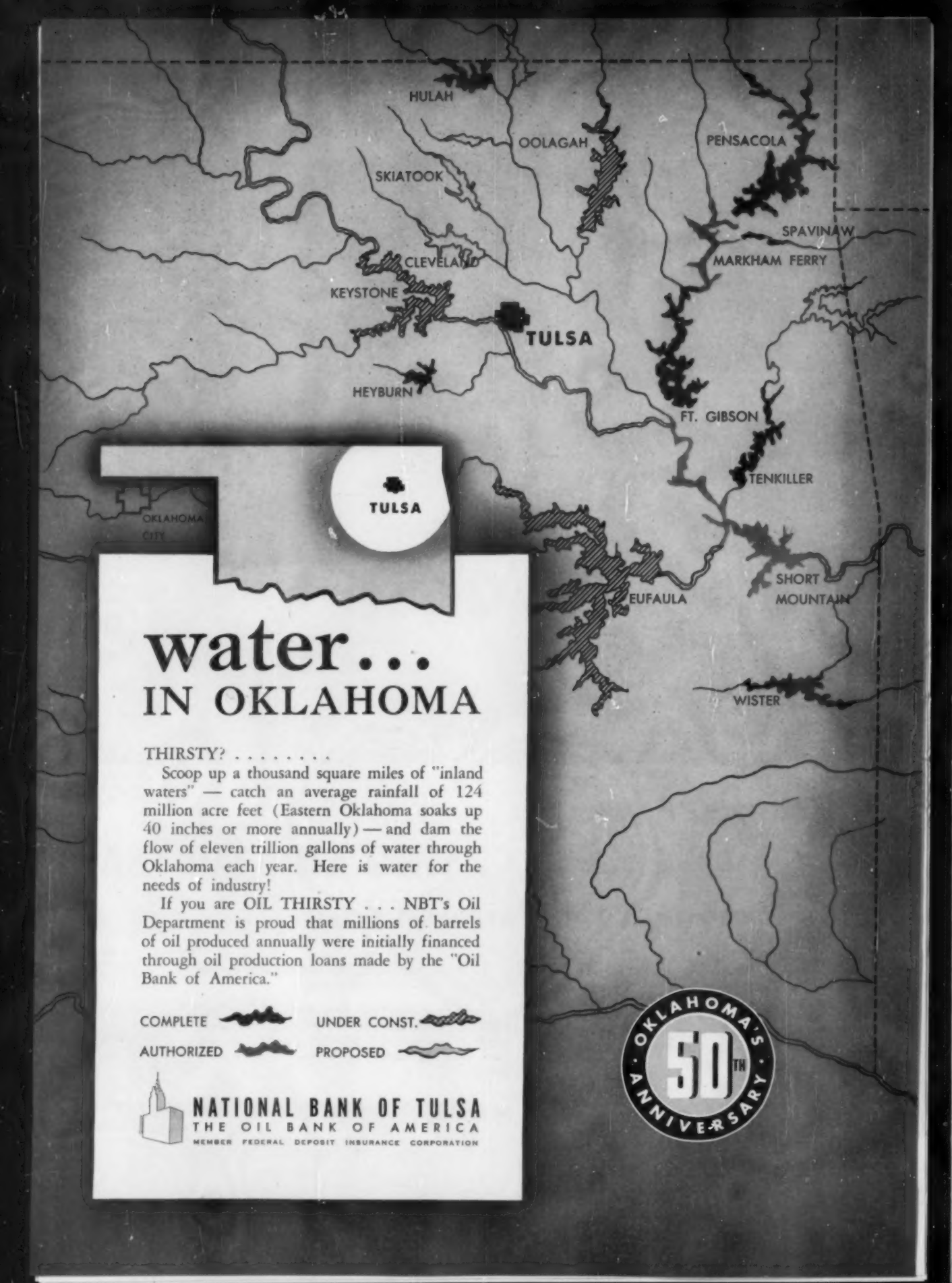
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If you are OIL THIRSTY . . . NBT's Oil Department is proud that millions of barrels of oil produced annually were initially financed through oil production loans made by the "Oil Bank of America."
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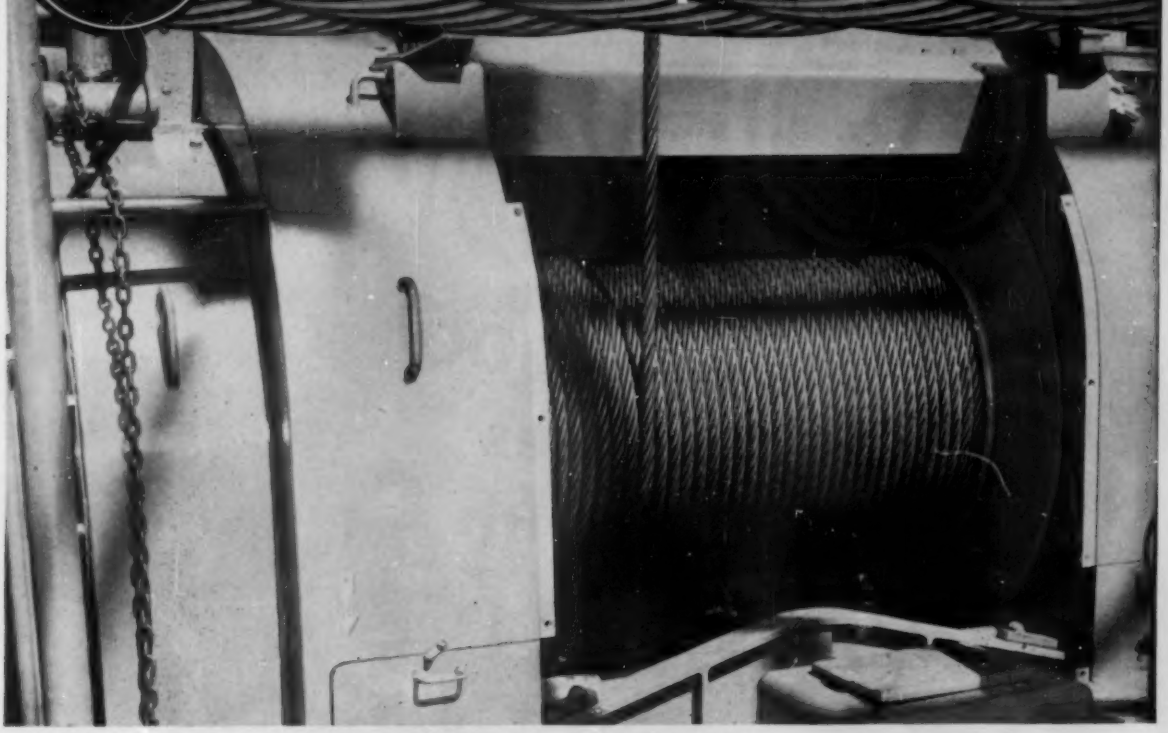
American Cable TRU-LAY VHS | 15% STRONGER



New VHS Rotary Drilling Lines Give Higher Factor of Safety

Made of a new grade of steel for wire rope, new VHS drilling lines are 15% stronger than lines made of Improved Plow Steel—the best grade available before the introduction of VHS. This means that 10 lines of VHS have a factor of safety 14.9 or 15% higher than 10 lines of IPS. Or, to say it another way, the factor of safety for 10 lines of VHS is just about equal to the factor of safety for 12 lines of the same diameter in IPS.

Drill Faster, Cut "Down Time"

The additional strength of new VHS gives you many other advantages. For example you can drill deeper before increasing the number of parts of line—and make round trips faster. And VHS's greater strength often eliminates any necessity for buying new blocks or regrooving sheaves to use larger diameter lines for higher safety factor.

Resists Abrasion, Peening

In addition to its greater strength, VHS is also tougher. Because it is stronger *and* tougher it has greater resistance to abrasion, and higher resistance to peening . . . both are important factors in maintaining diameter and shape. Ton mile advantages should result if regular adaptable cut-off practices are followed.

Ordering Is Easy

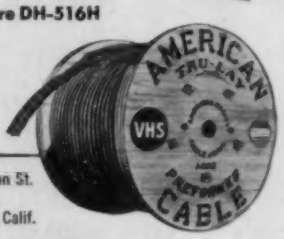
Nothing could be simpler than ordering VHS Rotary Drilling Lines. Just ask your nearest Mid-Continent Supply store for a VHS drilling line in the length and diameter you need. For further information write to the nearest American Chain & Cable Company office listed below for **Brochure DH-516H**

ACCO

American Cable Division
AMERICAN CHAIN & CABLE

630 McFarland St. Houston 1, Texas | 4555 E. 46th Ave. Denver 16, Colorado | 2216 S. Garfield Ave. Los Angeles 22, Calif. | 400 W. Madison St. Chicago 6, Ill.

Wilkes-Barre, Pa.; Odessa, Texas; New York, N.Y.; Philadelphia, Pa.; San Francisco, Calif.



Results of fracturing using Adomite and lease crude

Well	Formation	Gallons Fracturing Fluid	Pounds Sand	Injection Rate BPM	Production, BOPD Before	After	30-60 Days After	6 Months After
A.	San Andres	10,000	10,000	5	2	28	35	—
B.	San Andres	15,000	21,000	5	4	54	120	65
C.	Springer Sand	6,000	12,000	3	8	49	51	51
D.	Penn. Cgl.	6,000	6,000	4	*	345**	144	80
E.	Miss. Chat	6,000	12,000	10	Dead	435	306	192
F.	Miss. Chat	6,000	10,000	5	10	—	33	30
G.	Miss. Chat	6,000	12,000	10	*	—	330**	360***
H.	Clear Fork	10,000				—	90	51
I.	Sussex [illegible]					53	45	52
						9	180	99
						9	67	51
							80	68
							49	30

More than 10,000 success stories fracturing with Adomite

Adomite® — and only Adomite does so many things so effectively!

Seals the fracture face . . minimizes fluid loss . . . no damage to formation.

Longer fractures . . . deeper penetration of sands.

Fewer sandouts . . . reduces fluid loss in rock matrix, prevents buildup of sand concentrations in the fractures.

Saves you money . . . utilizes your own lease crudes . . . saves transportation costs.

Decreases friction loss . . . low viscosity of Adomite-created fracturing fluids permits use of less pumping equipment than with viscous refinery residuals.

Reduces hazard of emulsions . . emulsion-breaking characteristics are important consideration to many producers.

Adaptable to virtually all types of crude, Adomite is all you need to control fluid loss of kerosene, crudes, gelled crudes or refinery residuals.

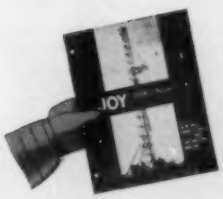
Producers who say Adomite . . stay with Adomite.

© 1957, Continental Oil Co.

Get greater profits from your next fracturing job

TELL YOUR SERVICE COMPANY TO USE Adomite

SLIM HOLES TO 5100 FEET WITH THE *Joy* 510



Get the complete story on this modern slim hole rig . . . write for Bulletin 154-31

HERE'S A RIG DESIGNED FOR SLIM HOLE WORK—either deep exploration or slim hole production. It's completely portable, mounted on a single trailer for fast rig-up and tear-down . . . lightweight, yet has all the rugged features of the largest rigs: LARGE ROTARY TABLE OPENING with standard API taper . . . AIR CLUTCHES for sensitive control of hoisting drums and rotary drive . . . TORQUE CONVERTER for infinitely variable speed and torque multiplication. Find out more about the economies of operating this true slim hole rig . . . write to ***Joy Manufacturing Company, Oil Field Drill Division, P.O. Box 35326, Airlawn Station, Dallas 35, Texas.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

WSW O 6469-154

JOY . . . EQUIPMENT FOR THE OIL FIELDS . . . FOR ALL INDUSTRY

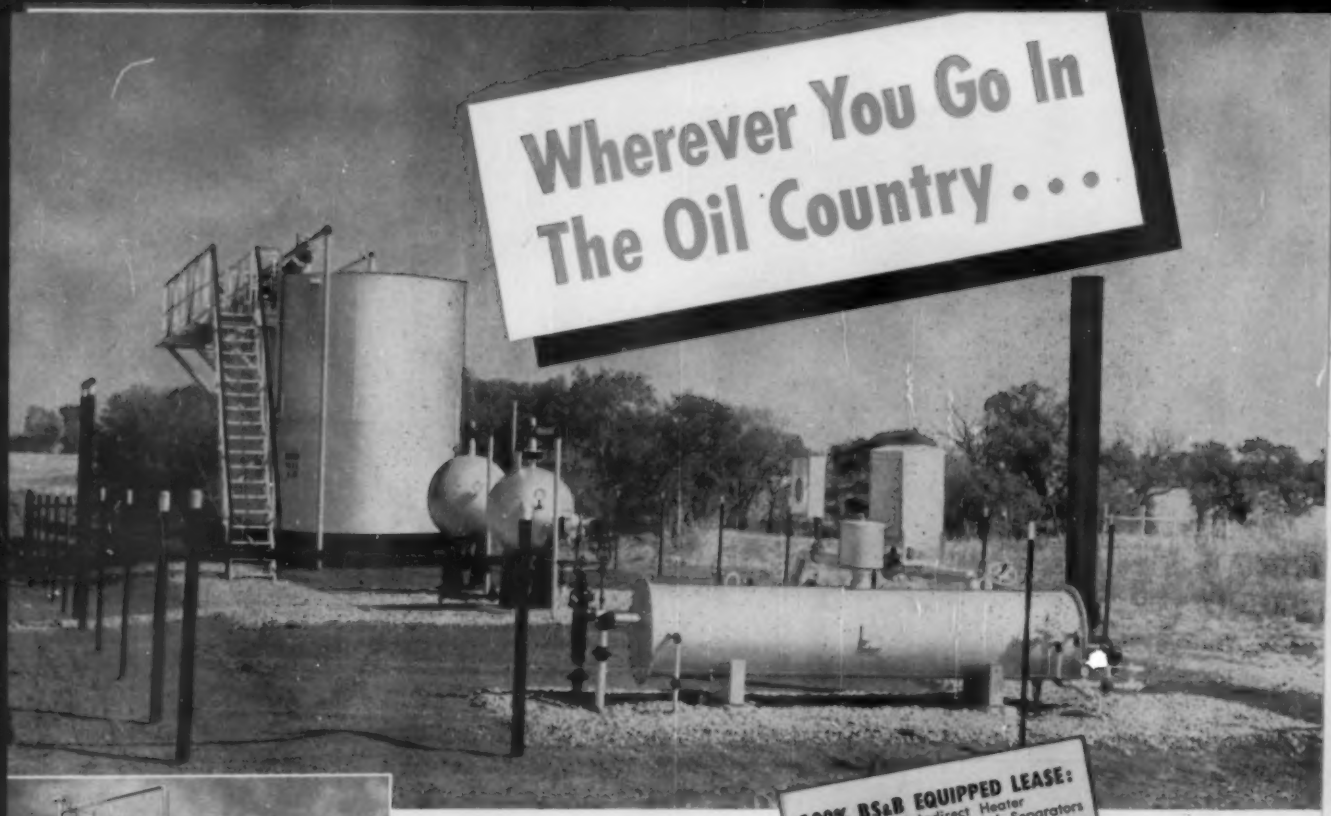
27 SALES & SERVICE LOCATIONS

Denver, Colo.; Salt Lake City, Utah; San Francisco and Los Angeles, Calif.; El Paso, Texas; Carlsbad, N.M.

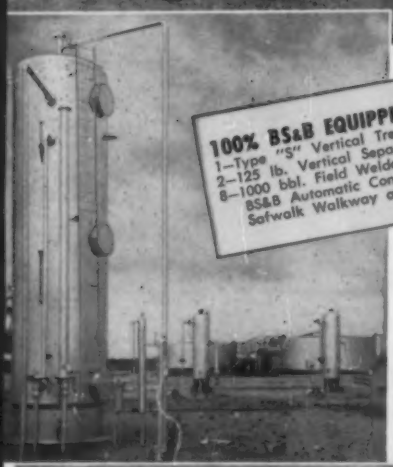
Baash-Ross Tool Co. Div.—Abilene, Corpus Christi, Houston and Odessa, Texas; Harvey, New Iberia and Shreveport, La.; Ardmore and Oklahoma City, Okla.; Avenal, Bakersfield, Long Beach, Newhall, Taft, and Ventura, Calif.; Casper, Wyo.; Hobbs and Farmington, N.M.; Olney, Illinois.

Export Sales—Joy Manufacturing Company, 60 E. 56th St., New York, N.Y.

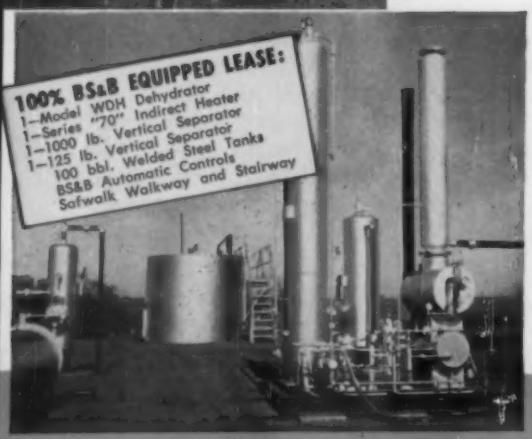
Wherever You Go In The Oil Country . . .



100% BS&B EQUIPPED LEASE:
1—Series "70" Indirect Heater
2—Model "OGS" Spherical Separators
2—200 bbl. Welded Steel Tanks
BS&B Automatic Controls
Safwalk Walkway and Stairway



100% BS&B EQUIPPED LEASE:
1—Type "S" Vertical Treater
2—125 lb. Vertical Separators
8—1000 bbl. Field Welded Steel Tanks
BS&B Automatic Controls
Safwalk Walkway and Stairway



100% BS&B EQUIPPED LEASE:
1—Model WDH Dehydrator
1—Series "70" Indirect Heater
1—1000 lb. Vertical Separator
1—125 lb. Vertical Separator
100 bbl. Welded Steel Tanks
BS&B Automatic Controls
Safwalk Walkway and Stairway

You'll Find More And More Leases Equipped 100% BS&B!

"One good piece of BS&B oilfield lease production equipment deserves another"... that seems to be the trend of thought of an ever increasing number of lease operators these days!

Many of them have tried first one, then another of BS&B's many equipment items... heaters, treaters, separators, low temperature separation systems, dehydrators, water knockouts, desulfurizers, tanks, automatic controls, safety heads, etc.

Their complete satisfaction with the equipment in terms of quality, initial cost, maintenance cost, performance and payout time has led them to convert to BS&B *exclusively* on new lease production equipment purchases.

If *you* are planning to put a new lease on production or replace equipment on an old one, take a tip from these profit-wise operators and go 100% BS&B! Better get in touch with your BS&B Man today!

OVER 60 YEARS BS&B RELIABILITY — ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

BLACK, SIVALLS & BRYSON, INC.
Oilfield Equipment Division, Dept. 1-A4
P.O. Box 1714 Oklahoma City, Oklahoma

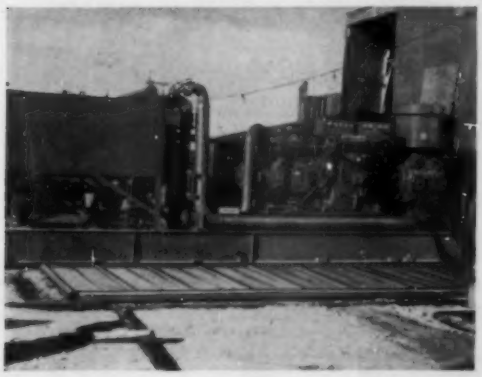
NOW all the air you need for drilling from one compressor

When you need air for aerated mud drilling why use a dozen compressors when one will do the job! The Air-Pac packaged air compressor has proved highly successful in field service.

The Air-Pac is a completely automatic 500 horsepower compressor, belt-driven off the rig's compound. The Air-Pac will automatically maintain any desired discharge pressure between 500 and 1500 psi. An automatic controller also holds the input horsepower steady over the complete range of pressures to eliminate engine stalling. The balanced/opposed design of the compressor means you don't have to fuss with it when you install it. Set it on timbers . . . it won't "walk" away. There is nothing intermittent about the Air-Pac either . . . use it for one or 5000 hours.

Low pressure units are also available for air drilling, incorporating all the features of the high pressure aerated mud unit. For a packaged air compressor that's just as rugged as the rest of your rig...be sure you look into the Clark Air-Pac.

"On the job." Notice that AIR-PAC is not bolted down. Strut rods to rig maintain belt tension.



CLARK BROS. CO. **OLEAN, NEW YORK**

One of the Dresser Industries

Offices in Principal Cities Throughout the World

CLARK **Air Drilling Compressors**

Another Big-Inch pipeline goes Polyken

88 MILES OF NEW 20" LINE IN THE NATURAL GAS PIPELINE COMPANY OF AMERICA SYSTEM TO BE WRAPPED WITH POLYKEN POLYETHYLENE TAPE

(from Wise County, Texas, to Carter County, Oklahoma)

Natural Gas Pipeline Company of America, subsidiary of Peoples Gas of Chicago, chooses this top quality coating and The Polyken Method which provides these 7 cost-cutting advantages:

1. Tremendous labor and equipment savings because of simplified operation.
2. Faster coating—consistent high daily output.
3. No hot dope preparation—tape is ever ready.
4. No cooling or drying time.
5. Vastly reduced warehousing, shipping, handling costs.
6. Liabilities virtually eliminated—no fumes, no burns, no need to worry about human and livestock hazards.
7. Wrap goes into ground in factory-uniform condition.

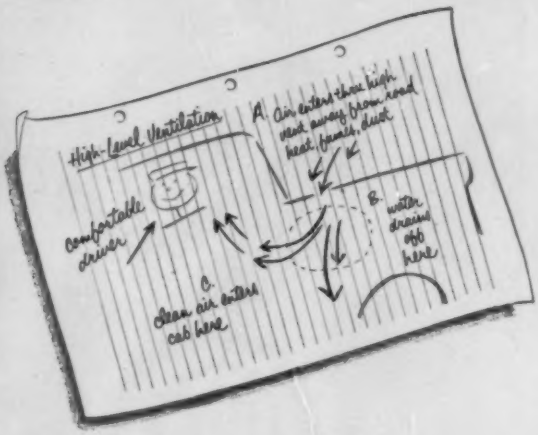
Complete catalog, Sweet's Industrial Construction File, Sec. 31/Ke

Polyken®

PROTECTIVE COATINGS

THE KENDALL COMPANY
Polyken Sales Division

in a Chevy cab, even the air is better!


High-Level Ventilation
A. Air enters here high, heat, away from road fumes, dust
comfortable driver
B. water drained off here
C. Clean air enters cab here

...more evidence that Chevrolet Task·Force Trucks are engineered better and built better for bigger savings!

These cab features give you extra comfort and safety behind the wheel, extra savings on truck maintenance. And they're proof that the most modern trucks for your money are Chevrolets!

The drawing "doodled" above shows how Chevy's High-Level ventilation provides a *comfortable* interior . . . and the numbers in the big picture point out other advantages equally as good to have around you when you haul! They include:

(1) *A roof that's specially built for safer, more comfortable hauling.* Sturdy all-steel construction adds to safety; roof's unique inner reinforcement insulates the overhead against heat.

(2) *A gleaming, durable baked enamel outside finish.* Here's the reason your Chevy's exterior will resist wear better, look like new longer! This handsome finish is available in a wide variety of colors.

(3) *A Nu-Flex seat that beats the bumps!* Deep-comfort coil springs, metered air shock damping and 3-way adjustment let you take it easy on tough jobs!

(4) *A cab that's rustproofed to last!* Doors and similar surfaces are rustproofed on the inside as well as on the outside by immersion.

(5) *Concealed Safety Steps for convenience.* Inside each cab door, they give you firmer footing, make entering or leaving the cab easier and safer.

(6) *An undercoated floor, cowl side panels and fender flanges.* Virtually all exposed surfaces on the underside of the cab are protected by an anti-rust coating.

(7) *A non-glare instrument panel to make driving safer!* The textured finish on upper portion of Chevy's instrument panel reduces blinding sun reflections, minimizes eyestrain.

(8) *A reliable 2-speed electric windshield wiper* on each side.* Powered by electricity, their action remains *constant* under all conditions.

Such advantages as these (we've shown only a few) combine to make *everything* better in a 1957 Chevrolet truck! You'll see for yourself when you visit your Chevrolet dealer's. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

**Standard in Series 5-6-7-8-9-10000 models.*

. . . biggest sellers because they're the biggest savers! CHEVROLET

CHEVROLET TASK·FORCE 57 TRUCKS

Oil Financing from the **FIRST** *in* **DALLAS**
goes where you go...

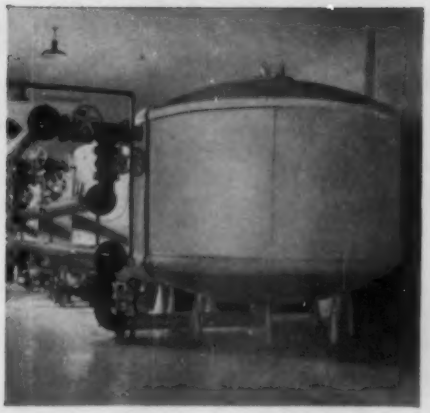
Russell Guffey on drilling site of Cooke County, Texas, operation. He is brother and partner of Roy Guffey, Roy Guffey Drilling Company, Dallas.

Specialized experience, organization, and resources to help you with practically any kind of need for "working money".

FIRST NATIONAL BANK IN DALLAS

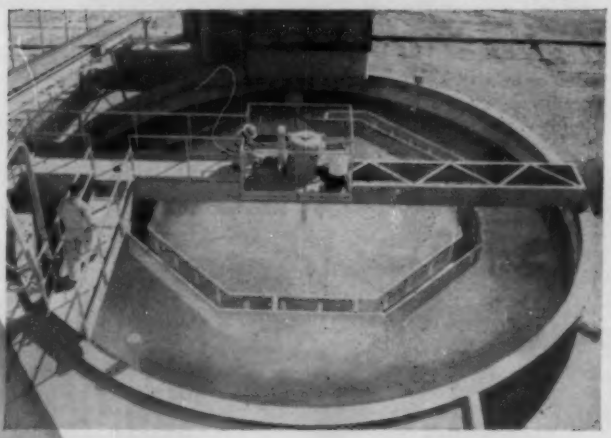
Member Federal Deposit Insurance Corporation

put FIRST financing
in your own oil future



Why General Filter?

There are many reasons why municipalities and industries have installed General Filter water treating plants:



INSTALLATION SUPERVISION . . . General Filter "job-engineers" each installation to the consulting engineer's specification . . . supervises the installation and trains the personnel who will work with the equipment.

OPERATIONAL DEPENDABILITY . . . for twenty years General Filter has concentrated all of its efforts toward "better water treatment". Their efforts have produced water treating plants and equipment that are *completely* dependable.

ENGINEERING KNOW-HOW . . . General Filter's design and construction engineers are familiar with the problems involved in water treatment.

GREATER ECONOMY . . . the only real test of economy is a long term test. General Filter plants stand up over the years providing "better water" with minimum maintenance, longer trouble-free, smoother operation.

Find out why you should specify General Filter . . . Write today for detailed information regarding your water treatment problems.

General Filter Company
AMES, IOWA
. . . *"better water"*

AERATORS • FILTERS • TASTE AND ODOR • ALKALINITY CONTROL • HIGH CAPACITY
RESINOUS ZEOLITE • IRON RUST REMOVAL • DEMINERALIZATION • SOFTENERS

PRESSURE REDUCING REGULA

EXHAUSTING TO COMMON HEADER

QUIET-TIGHT-RESPONSIVE

with

LOWEST MAINTENANCE

PRESSURE REDUCING REGULATOR

SAFETY RELIEF VALVE

MONITORING INSTALLATION

PRESSURE REDUCING REGULATOR

GROVE *flexflo* Regulators and Relief Valves are proved through a decade of effective service

A simple expansible tube serves as both diaphragm and valve. It's the only moving part, and outlasts ordinary valve mechanisms many times over. Instantly responsive, it closes over scale or foreign matter without leakage or damage. Shown here are typical town border and distribution station installations. Grove *flexflos* are also proved for more effective service with air, water, oil, and special fluids. For more accurate control, longer trouble-free service, and lower maintenance, investigate Grove *flexflo*.

- Control within narrow limits to full capacity
- Bubble-tight seal unaffected by foreign matter
- No metal parts to chatter, slam or bang
- No sticking, friction or corrosion problems
- Wide choice of manual or automatic pilot controls
- For temperatures to 150 F, working pressures to 1500 psi
- Available in iron or steel, 1" to 12"

702

GROVE *flexflo* VALVES

SUBSIDIARY OF WALWORTH

GROVE VALVE and REGULATOR COMPANY • 6529 Hollis St., Oakland 8, Calif.
HOUSTON 23—3517 Polk Ave. • • • • • LOS ANGELES 6—1930 W. Olympic Blvd.

GROVE SIMPLICITY ACCURACY SAFETY

ODESSA, TEXAS • TULSA, OKLAHOMA • CHICAGO, ILLINOIS • DENVER, COLORADO • In Western Canada: GROVE VALVE LIMITED, EDMONTON

ONE-TON TEST

proves physical strength of "Integrated" field coils in ALLIS-CHALMERS MOTORS

It's not likely a field coil of a motor would ever be punished this way. But tests like this illustrate the inherent ability of Allis-Chalmers "INTEGRATED" FIELD COILS to withstand the stresses created by the most severe loading conditions of a motor.

Available only on Allis-Chalmers Motors

"Integrated" field coils, available only on Allis-Chalmers motors, are enveloped in oriented glass fibers and heat-stabilized resins. These are securely locked to poles to resist mechanical force. High dimensional stability and tensile strength characteristics assure long life under the toughest of operating conditions.

Coils are surface sealed against atmospheric contaminants. In addition, the coefficient of expansion of insulation is similar to that of copper. Heat transfer qualities are excellent. "Integrated" coil structures can withstand the most severe thermal cycling found in normal operation.

Exclusive Allis-Chalmers

"Double-protection," combining new "Integrated" field coils with *Silco-Flex* all-silicone stator coil insulation, is available for rotating and stationary elements of large ac or dc machines with operating temperatures through Class B range.

For the whole story of Allis-Chalmers motors, contact your local A-C representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Silco-Flex is an Allis-Chalmers trademark.

ALLIS-CHALMERS

A-5276

You get more than gas treating chemicals from CARBIDE...

CARBIDE'S mono- or diethanolamine give you excellent removal of CO_2 and H_2S. By converting the extracted H_2S to sulfur or H_2SO_4, you benefit by recovering a valuable product—thus reducing your operating costs.

CARBIDE'S di- or triethylene glycol remove H_2O economically from gas streams. The low initial investment and low operating costs of glycol type plants provide minimum dehydration charges.

Plus Benefits

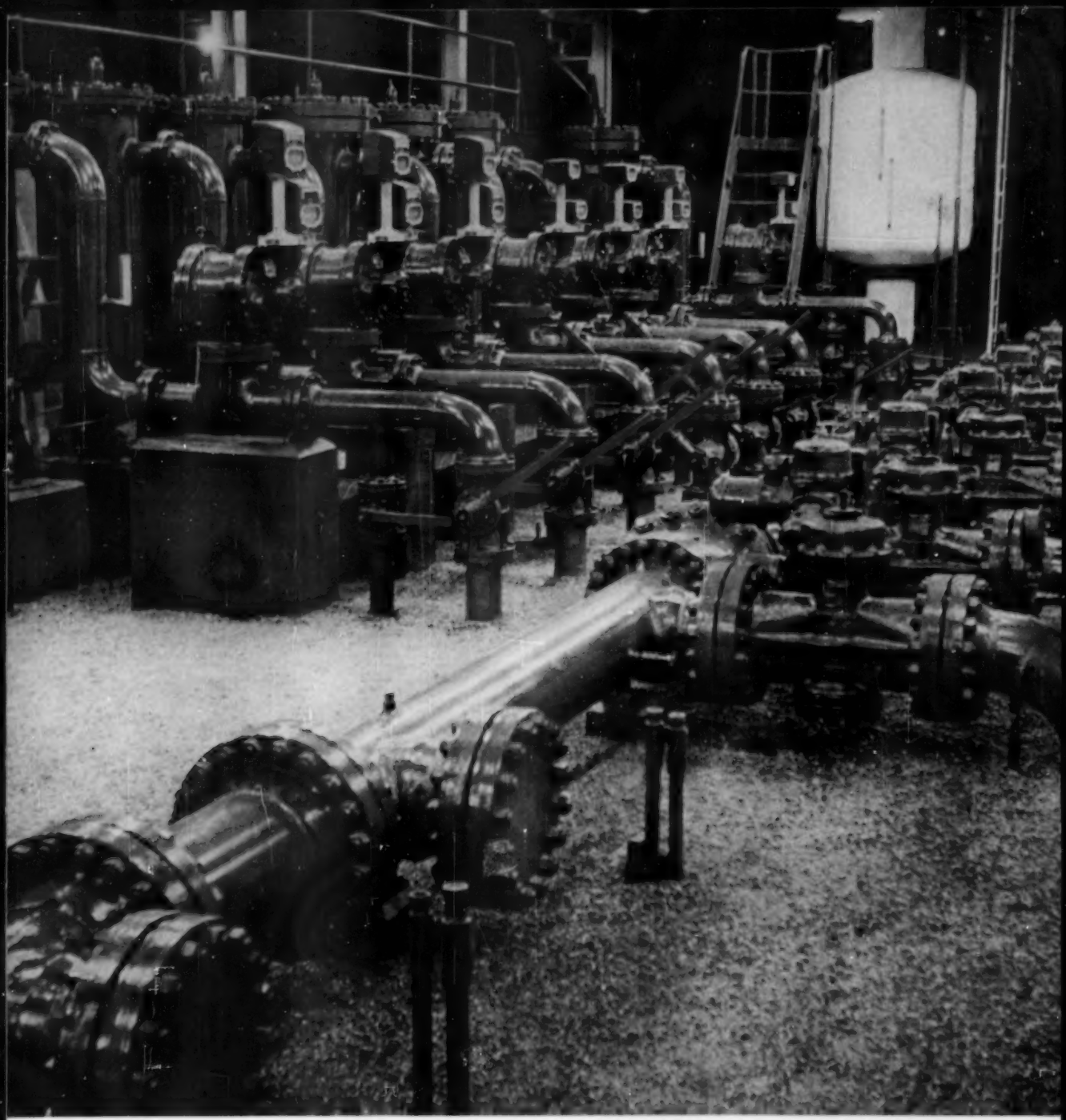
- Technical data gathered from 22 years experience producing and supplying gas treating chemicals. These data can help you in construction of new facilities, the enlargement of present equipment and in securing trouble free performance of existing plants.
- Technical help from field representatives and service laboratories.
- Fast delivery from warehouses located near major gas fields.
- Constant source of supply.

Find out for yourself how CARBIDE can help you. Write today to Carbide and Carbon Chemicals Company, Room 308, Department H, 30 East 42nd Street, New York 17, New York.

In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal. In Western Canada: Harrisons and Crossfield.

CARBIDE AND CARBON CHEMICALS

Carbide and Carbon Chemicals Company
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York 17, N.Y.



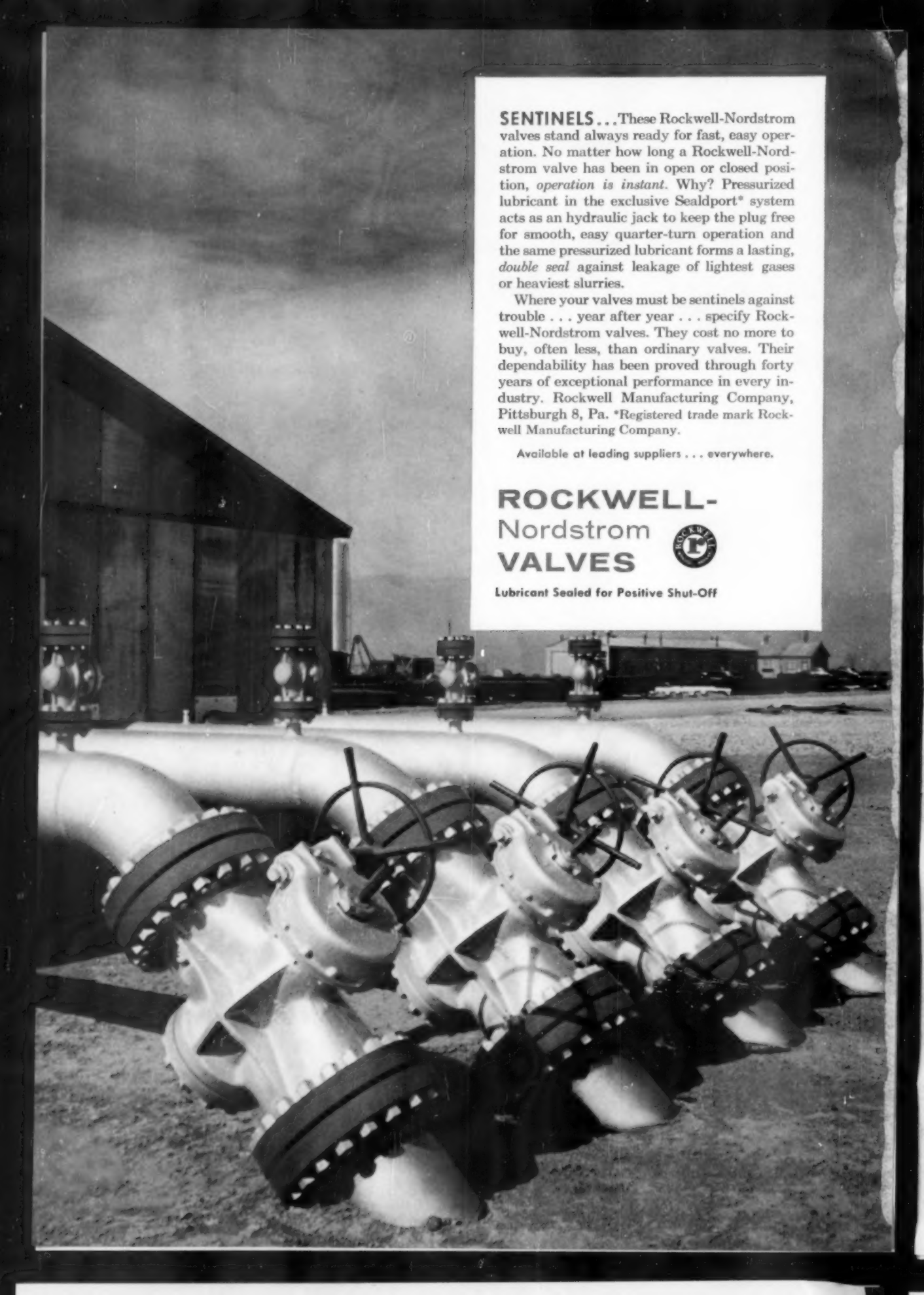
COMPACT DESIGN SAVES MONEY when you specify Rockwell-Nordstrom valves for tight manifolds like at the pipeline station above. (Rockwell Rotocycle meters are also shown.) Most Rockwell-Nordstrom valves take little more area than the diameter of the flanges—there are no bulky rising stems or cumbersome bonnet cavities. And less bulk means less weight too; that's another cost cutting bonus you gain for intricate piping arrangements in modern process plants.

You'll also save product loss and contamination because Rockwell-Nordstrom valves are lubricant sealed to be truly leakproof and to shut-off positively. From every standpoint, Rockwell-Nordstrom valves cost less to use and perform better. And they cost no more to buy, often less, than ordinary valves. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed For Positive Shut-Off



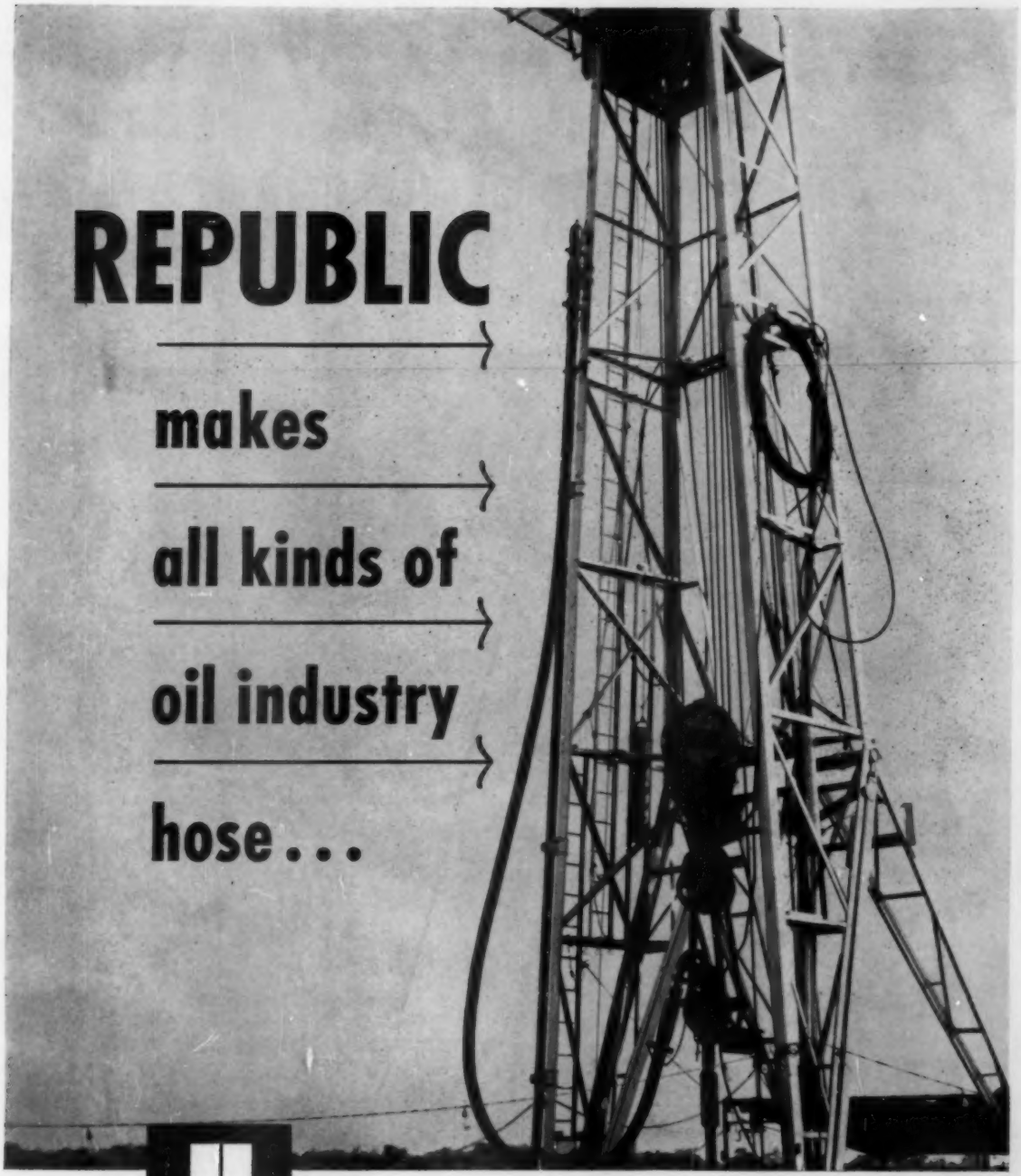
SENTINELS... These Rockwell-Nordstrom valves stand always ready for fast, easy operation. No matter how long a Rockwell-Nordstrom valve has been in open or closed position, *operation is instant.* Why? Pressurized lubricant in the exclusive Sealdport* system acts as an hydraulic jack to keep the plug free for smooth, easy quarter-turn operation and the same pressurized lubricant forms a lasting, *double seal* against leakage of lightest gases or heaviest slurries.

Where your valves must be sentinels against trouble . . . year after year . . . specify Rockwell-Nordstrom valves. They cost no more to buy, often less, than ordinary valves. Their dependability has been proved through forty years of exceptional performance in every industry. Rockwell Manufacturing Company, Pittsburgh 8, Pa. *Registered trade mark Rockwell Manufacturing Company.

Available at leading suppliers . . . everywhere.

ROCKWELL-
Nordstrom
VALVES

Lubricant Sealed for Positive Shut-Off



REPUBLIC

makes

all kinds of

oil industry

hose . . .

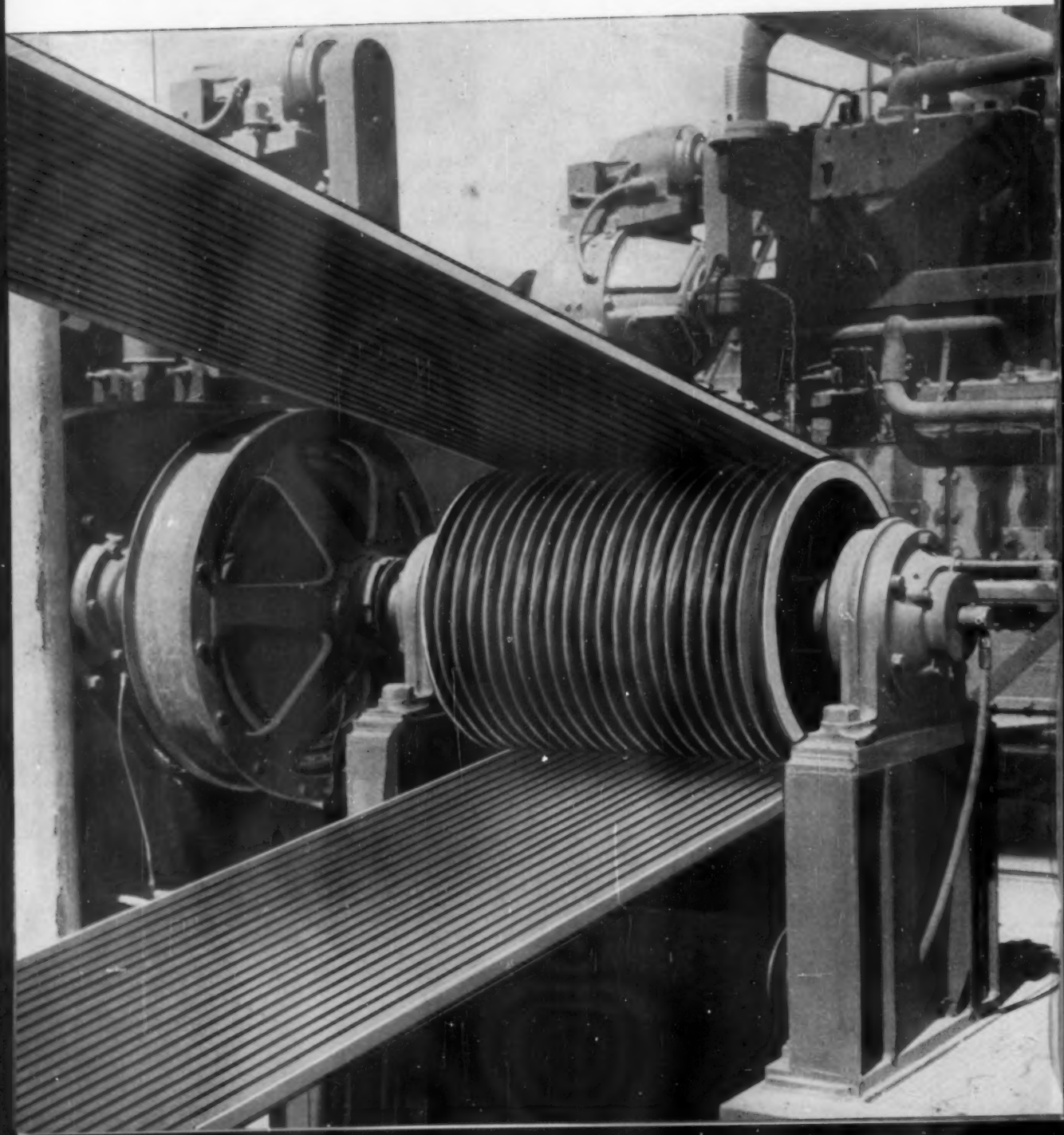
SUPPLY . . . STORES STOCK REPUBLIC HOSE

Stocked in the Mid-Continent Area by
JONES & LAUGHLIN STEEL
CORPORATION, Supply Division
P.O. Drawer 2481, Tulsa 2, Okla.
and the J & L Store
in YOUR field.

REPUBLIC RUBBER DIVISION
LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1 OHIO
INDUSTRIAL RUBBER PRODUCTS

Stocked on the West Coast by
HENDRIE BELTING & RUBBER CO.
405 Towne Ave., Los Angeles, Calif.
PACIFIC COAST RUBBER COMPANY
51 Main St., San Francisco, Calif.

WHY MULTI-MATCHED MAKE YOUR MAINTENANCE DOLLAR



DAYTON V-BELTS STRETCH FARTHER

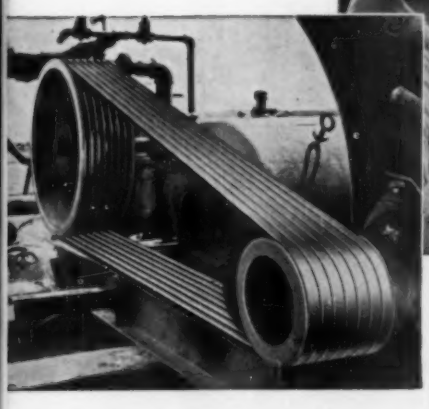
Precision matching assures long, uniform life for every V-Belt in a set

In transmitting power to mud pumps and draw works the service life of the *set* is the important thing. Premature failure of one or two V-Belts in a set is costly. And only when a set is accurately matched can it give the long trouble-free performance that makes your rig maintenance dollars cover more ground.

To be certain you get the longest possible service, Dayton *multi-matches* every set. Strict quality controls make every V-Belt as alike as possible in construction. Then they are matched in the factory on precision machines. Again and again at Regional and District Warehouses matching is checked and re-checked. Always the same type of precision equipment is used.

These matching machines, called Matchometers, are designed and built exclusively for Dayton. Their repeated use is your assurance that each Dayton V-Belt in a set will pull its share of the load.

Next time you order, remember *multi-matched* Dayton V-Belts. You can get them at any of the supply points shown at right.



Every set of Dayton Thorobred V-Belts is *Multi-Matched* on precision Matchometers, the finest device made for matching V-Belts, built exclusively for Dayton Rubber Company.

© D.R. 1957

World's Largest Manufacturer of V-Belts

Dayton Rubber

The Dayton Rubber Company, Industrial Replacement Div., Dayton 1, Ohio

Dayton V-Belts Available Through over a Hundred Oil Field Supply Points

DAYTON REGIONAL WAREHOUSES

Los Angeles, Calif.—909 East Slauson
Dallas, Texas—925 Slocum
Houston, Texas—1308 La Branch

DAYTON DISTRICT WAREHOUSES

California
Bakersfield—109 23rd St.
San Francisco—401 Howard St.

Louisiana
New Orleans—632 S. Peters St.
Shreveport—214 N. Market St.

Texas
Abilene—628-30 Walnut St.
Corpus Christi—1920 N. Port Ave.
El Paso—1701 Texas St.
Odessa—111 N. Lee St.
Pampa—159 S. Cuyler St.
Wichita Falls—1300 Indiana Ave.

FIELD STORE STOCKS

Arkansas
All Republic Supply Stores

California
All Bethlehem Supply Stores
Bakersfield—Power Transmission and Equipment Co.
San Francisco—H. N. Cook Belting Co.

Colorado
All Republic Supply Stores

Illinois
All Republic Supply Stores

Kansas
All Republic Supply Stores
Coffeyville—Acme Foundry Co.

Louisiana
All Republic Supply Stores
Lake Charles—
Behring's Bearing Service of La., Inc.
New Orleans—
New Orleans Belting and Bearing Co.
Oil City—Oil City Hardware Co.
Shreveport—Bearing Transmission Co.

Nebraska
All Republic Supply Stores

New Mexico
All Republic Supply Stores

Oklahoma
All Republic Supply Stores
Oklahoma City—Green Head Service Co.

Texas
All Republic Supply Stores
Abilene—Carpenter V-Belt Co.
Amarillo—Radcliff Supply Co.
Beaumont—Behring's, Inc.
Borger—Radcliff Supply Co.
Brownsville—Alamo Iron Works
Cisco—Walton Electric Co.
Corpus Christi—Alamo Iron Works
Bradley's Motor & Armature Works
Houston-Oil Field Material Co.
Stewart Dean Co.
El Paso—El Paso Saw & Belting Co.
Freer—Houston-Oil Field Material Co.
Houston—
Behring's Bearing Service Co.
Houston-Oil Field Material Co.
Kilgore—Jack Anderson Engine Co.
Lubbock—Lubbock Electric Co.
Bearing Specialists Co.
Lufkin—Lufkin Foundry & Machine Co.
Midland—Electric Motor Service Co.
Odessa—Duke Electric Co.
Pampa—Radcliff Supply Co.
Pearsall—Houston-Oil Field Material Co.
San Antonio—Alamo Iron Works
Wichita Falls—Mims Bearing Co.
Hornsby Heavy Hardware Co.

Wyoming
All Republic Supply Stores

Owners know that every Allis-Chalmers engine is backed by the company's long reputation for building engines that are *tops* in dependability and economy — engines totaling hundreds of thousands of horsepower.

Operators like the continuous-duty rugged power, the reserve built into their Allis-Chalmers engines. As loads increase, these high-torque engines lug right through.

They ALL Like Allis-Chalmers Engines...

Mechanics find there are less parts — that they are simple, easily accessible, require fewer adjustments. Maintenance time is reduced to a minimum.

Everyone likes the Allis-Chalmers *3-deep* service from the dealers, the 18 branches and the factories.

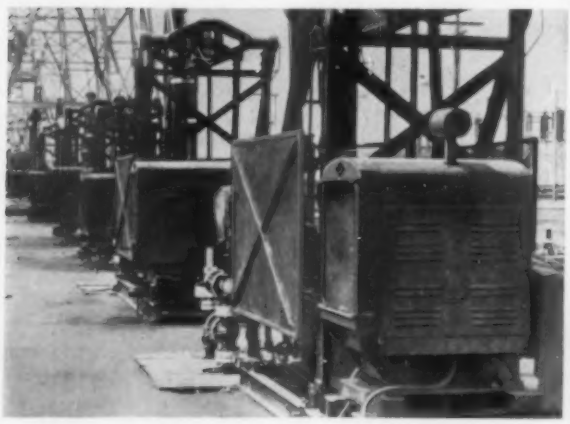
For more reasons why "they all like Allis-Chalmers engines," see your Allis-Chalmers engine dealer, or write for detailed information.

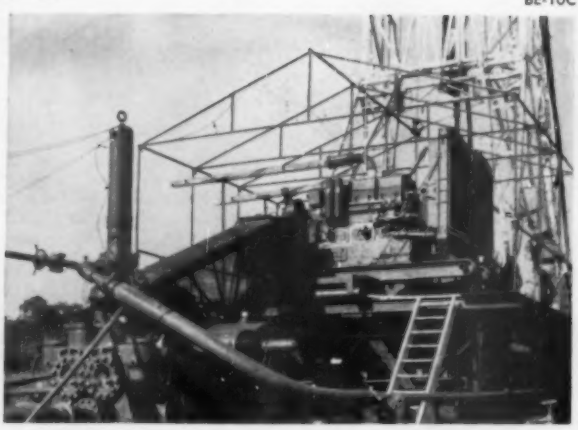
ALLIS-CHALMERS, BUDA DIVISION, MILWAUKEE 1, WISCONSIN

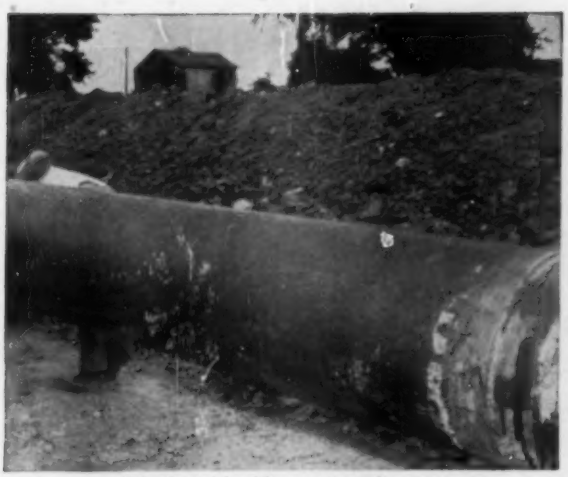
ALLIS-CHALMERS

Allis-Chalmers engines are an ideal source of power for any oil field requirement. They are heavy-duty and conservatively rated for long life and dependability.

BE-10C







Pipe, buried for 25 years, is good as new

Applying NO-OX-ID "GG" over the cleaned surface

Next, No. 4 NO-OX-IDized wrapper for protection against abrasion

Finally, NO-OX-ID Filler Red "C," a seal coat, completes protection

THIS PIPE IS 25 YEARS YOUNG

Twenty-five years ago NO-OX-ID combinations sealed this pipe against corrosion. Today, after two and one-half decades of uninterrupted service, the pipe is as good as new.

HOW DO WE KNOW THIS?

Recently, new construction made relocation of the line necessary. Inspection revealed the original NO-OX-ID coatings and wrappers had chemically and mechanically stopped moisture penetration and corrosive attack. *Not a foot of pipe was replaced.* After cleaning and a new application of NO-OX-ID coating-wrapper combination, the pipe was lowered in. It's now ready for many more years of additional service.

Many leading pipeline companies and utilities rely on NO-OX-ID combinations for lasting pipeline protection. Consult your Dearborn representative next time you move pipe or lay new lines for the right combination to meet your soil conditions.

NO-OX-ID ADVANTAGES

Coats more feet per man-hours because less material is needed • Applied hot or cold • By hand, by Traveliner or at the mill • Requires less equipment • No noxious fumes.

USE THIS COUPON FOR MORE INFORMATION

Dearborn NO-OX-ID®

For Long-Term Protection Against Pipe Corrosion

Dearborn Chemical Corporation
Dept. OG, Merchandise Mart Plaza
Chicago 54, Illinois

Gentlemen:

☐ Have a Dearborn Pipeline Representative call
☐ Send me NO-OX-ID literature

Name.....*Title*.....
Company.....
Address.....
City.....*Zone*....*State*.....

Years of effective mud conditioning prove high performance of PALCOTAN

DEVELOPED THROUGH PALCO RESEARCH

Over four years of continuous large scale commercial use in important drilling areas throughout the world now back up the findings of over a decade of field and laboratory research. *Palcotan*, the unusual chemical extract of California redwood bark, has "come of age" as a low cost, stabile, easy to handle compound to control viscosity, gel strength and water loss in drilling muds. Now, for the first time, following the third in a series of plant expansions, *Palcotan* is available in sufficient quantity to meet all requirements. So if previous shortage has prevented your use of *Palcotan* in the past, plan now to put it to work. Exceeding specifications for quebracho in many applications, *Palcotan* is particularly efficient in low concentrations, is readily soluble in cold water, may be added with or without caustic, and comes in a non-toxic coarse powder form packed in convenient multiwall 50 lb. bags. Write today for full information.

Available through oil field and mud service organizations

Write for Bulletin No. 4-01 describing the properties and operating advantages of Palcotan

THE PACIFIC LUMBER COMPANY
100 Bush Street, San Francisco 4, California

Even offshore, where corrosion is severe, **Humble's coatings** give effective protection!

Humble Oil & Refining Company

On costly offshore drilling platforms, Humble's protective coatings have *proved* their ability to resist the powerful corrosive action of salt water splash, spray and vapor. There's a Humble protective coating for every surface from the splash-zone to the crown block, including the working platform and structures on the platform.

For the platform itself, excellent results have been obtained by using a six-coat vinyl system, including one vinyl mastic coat, to a total dry film thickness of from 14 to 16 mils Humble's vinyl protective coatings produce a tough, flexible film that gives remarkable resistance to weathering

HUMBLE

At your request, one of Humble's trained engineers will make a thorough study of your needs and give you complete protective coating recommendations. For more information on this service, and on Humble's complete line of protective coatings, call your Humble salesman, or phone or write:

Technical Service
Sales Department
Humble Oil & Refining Company
P. O Box 2180
Houston 1, Texas

Where explorers drill Gardner-Denver equipment usually is on the job

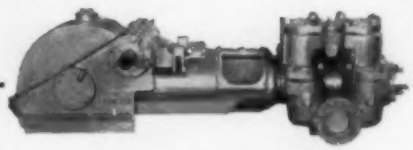
Oil finding by seismographic methods has widespread acceptance. So have rigs equipped with Gardner-Denver compressors and pumps.

Two of the most popular Gardner-Denver units used on seismograph rigs—such as the truck-mounted rotary unit shown here—are the FXG pump and the WC compressor.

PARTS AND SERVICE

—for compressors and pumps—available in 39 domestic and 16 foreign branches. Both compressors and pumps give dependable performance in remote locations.

Write for details.



FXG PUMPS

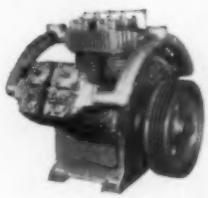
Eccentric design—for low bearing pressures . . . extra large, straight-through main shaft.

Herringbone gears—quiet, smooth-running.

Enclosed power end—keeps out dust, mud.

Automatic flood lubricating system in power end.

Valves accessible individually for easy inspection.



WC AIR-COOLED COMPRESSORS

Compact—save space on the seismograph rig.

Positive pressure lubrication system.

Adjustable tapered roller main bearings.

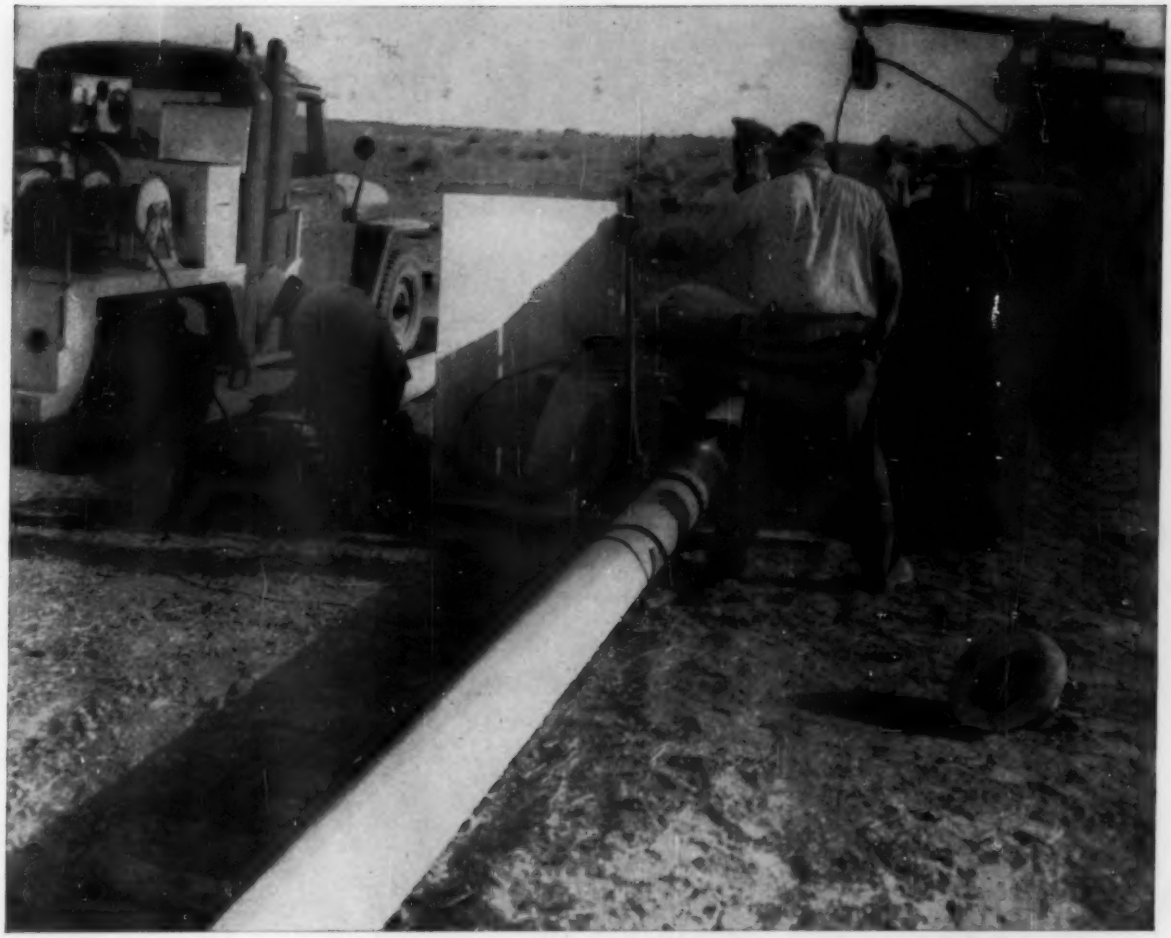
W-type single-stage compressors available in capacities from 213 to 1029 cfm at 870 RPM.

Circumferencial fins for even cooling and expansion all around cylinders.

ENGINEERING FORESIGHT—PROVED ON THE JOB
IN GENERAL INDUSTRY, CONSTRUCTION, PETROLEUM AND MINING

GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois—Gardner-Denver Export Division, 233 Broadway, New York, N. Y. In Canada: Gardner-Denver Company (Canada), Ltd., Toronto 16, Ontario. Oil Field Offices: Dallas, Houston, Tulsa, St. Louis, Los Angeles, New York, Pittsburgh, Denver, New Orleans, San Francisco, Kansas City, Edmonton, Winnipeg.



High quality welded joints for aluminum pipe are easy with Alcoa's field-proved welding techniques.

WHY WAIT? END YOUR PIPE SUPPLY PROBLEMS NOW!

Alcoa Aluminum Pipe offers . . .

IMMEDIATE DELIVERY—ALCOA Aluminum Pipe can be delivered in quantity *right now*. A range of popular sizes of lightweight pipe is in stock at most major oil field supply houses. Your nearby ALCOA sales office can give you their names and locations. Quick delivery can be made on other sizes and schedules.

EASY WELDING—Welding techniques job-proved by ALCOA make it easy to get durable welded joints between sections of aluminum pipe. *Automatic welding equipment* is available to speed laying of longer lines.

LOW LAYING COST—Its light weight makes aluminum pipe unusually easy to handle. A few trucks and men can handle remarkable quantities of pipe to keep costs down.

LONG SERVICE LIFE—The natural corrosion resistance of aluminum plus its rugged mechanical durability insures long, trouble-free service life . . . with only normal care in installation and operation.

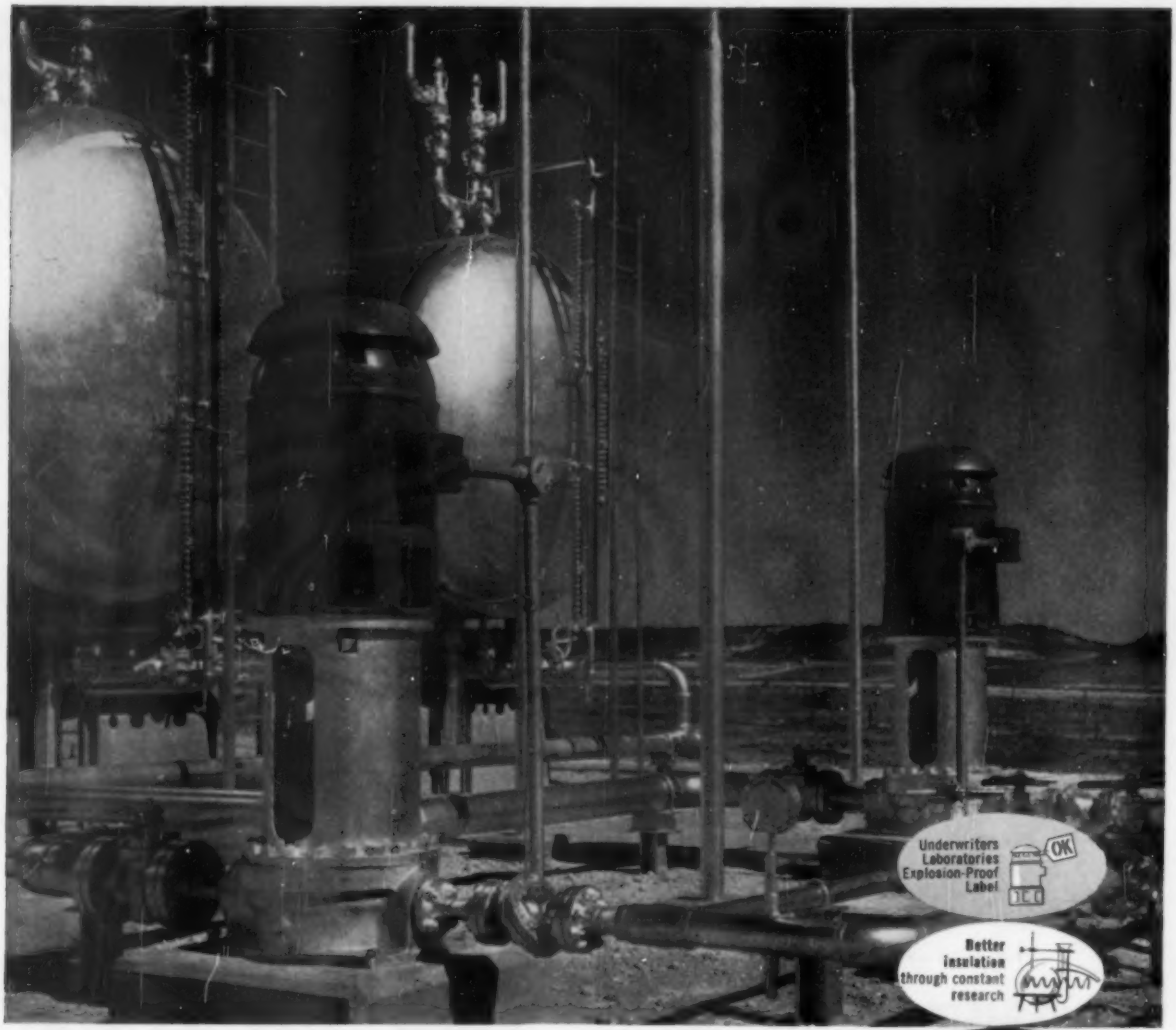
ALCOA pipe and engineering assistance were used in the original all-aluminum field-welded pipeline for petroleum in 1948. That pioneering created know-how you can rely on . . . to help you make ALCOA Aluminum Pipe the practical, economical solution to many of your most troublesome pipeline problems. For immediate technical aid or detailed literature, use the convenient coupon.

THE ALCOA HOUR
TELEVISION'S FINEST LIVE DRAMA
ALTERNATE SUNDAY EVENINGS

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA
921-D Alcoa Building, Pittsburgh 19, Pa.
Send me the FREE BOOKLET:
☐ Alcoa Aluminum Pipe for Oil Country Service
☐ Alcoa Aluminum Pipe and Fittings
My pipelining problem is:

Name _____ Title _____
Company _____
Address _____
City _____ Zone _____ State _____



Here's dependable all-weather power

Louis Allis vertical motors are designed for outside petroleum installations

Here's a pump drive keyed to match the particular specifications of the petroleum industry.

Louis Allis vertical solid-shaft motors are explosion-proof for operation in hazardous locations, and corrosion-resistant to ward off both the etching acids in cat-cracking plants and the corroding action of salt spray at sea-exposed installations.

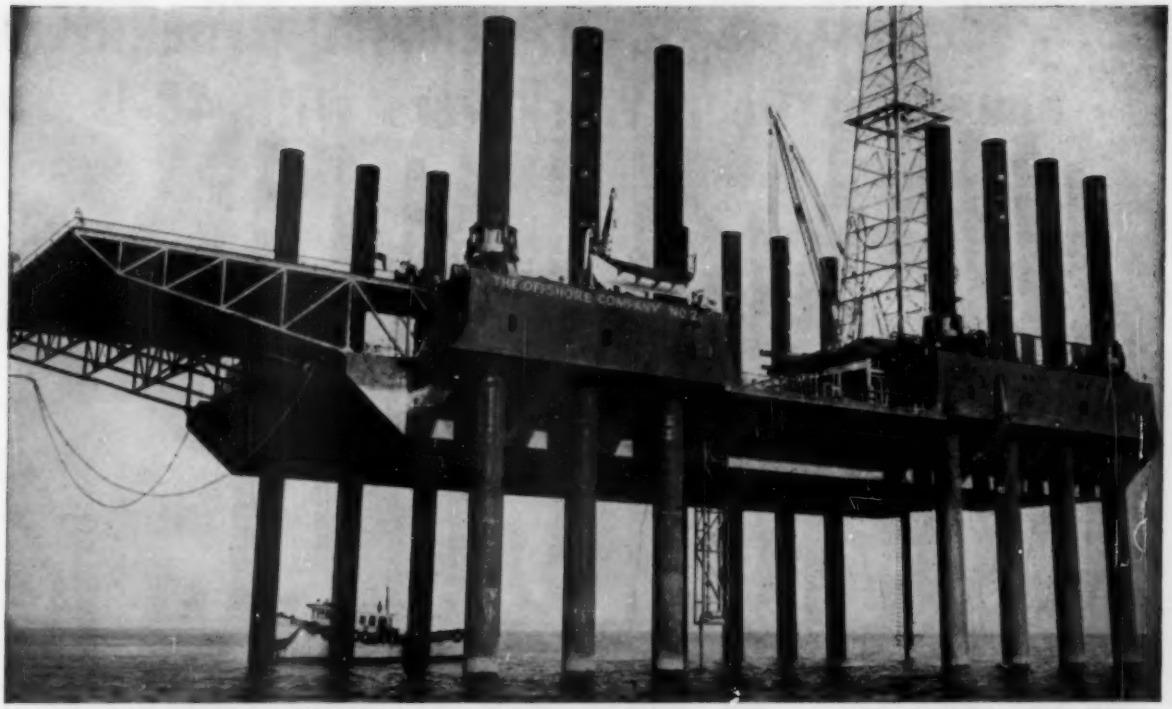
Tough, impervious insulation plus well-designed fully-enclosed construction give ample protection against weather, including dust- or rain-storms.

These motors are no problem for maintenance men, either. Easily mounted and wired up, they require little care afterwards. Tested quality bearings and ample lubrication reservoir keep them trouble-free. The locked bearing construction assures long life.

Louis Allis has a complete line of Explosion-Proof motors, with speeds to 3600 rpm., and sizes up to 600 hp. Ask for Bulletin 800 at your nearby Louis Allis District Office or write The Louis Allis Co., 449 East Stewart Street, Milwaukee 1, Wisconsin.

LOUIS ALLIS

MANUFACTURER OF ELECTRIC MOTORS AND ADJUSTABLE SPEED DRIVES



OFFSHORE COMPANY'S MOBILE RIG 52 on location 45 miles southeast of Cameron, La. The Queen of the Offshore fleet is operating here in 58 feet of water, with a planned hole depth of about 9,000 feet.

EXCEPTIONAL COMMUNICATION NEEDS OF OFFSHORE COMPANY MET BY GENERAL ELECTRIC KNOWHOW

To obtain dependable two-way radio communication with its rigs and cars throughout the Louisiana Gulf Coast from headquarters in Baton Rouge, the Offshore Company needed more than a normal two-way radio system. General Electric engineers solved Offshore's communication problem of extra-long distances between mobile locations by designing the Offshore radio system around a centrally located base station remotely controlled from Baton Rouge, La.

Offshore's main transmitter, a 250-watt G-E unit, is located 46 miles south of Baton Rouge with its antenna atop a 450-foot tower. This base station, remotely controlled from Offshore's Baton Rouge headquarters by means of a 450-megacycle relay link, has the effect of doubling Offshore's radio coverage to the south.

SELECTIVE PAGING

Another unique feature of Offshore's General Electric radio system is electronic selective paging. This allows the Baton Rouge dispatcher to sound a buzzer on the desired offshore or inland rig when no one answers his call. The buzzer, which can be heard throughout the rig, greatly increases the speed with which radio messages get through to the person sought.

The equipment operated by Offshore includes 250-watt General Electric two-way radio stations on 15 rigs and 60-watt units in 13 company cars. The company reports excellent ranges and dependability from all its radio units...over land *and* over water.

General Electric communication engineers can solve your communication problems with a well-planned radio system, utilizing the finest two-way radio made—the Progress Line. Such exclusive standard features as 6600-series communication-type tubes and controlled reluctance microphones, plug-in versatility, and low-cost maintenance based on a nationwide network of authorized service stations make the Progress Line your best assurance of dependable mobile communications.

Call in the General Electric communication experts; let them show you how well a Progress Line radio system will fit your specific needs.

FOR SALES AND SERVICE see "Radio Communication Equipment" in your Yellow Pages. Or, write: General Electric Company, Communication Products Department, C5147-1, Electronics Park, Syracuse, New York. *In Canada, write:* C.G.E. Electronics, 830 Lansdowne Avenue, Toronto.

Progress Is Our Most Important Product

GENERAL ELECTRIC

NEW Bucyrus-Erie 85-Ft. SERVICING DERRICK Simplifies Deep Workovers with 48-L

Here's an important addition to the long list of significant Bucyrus-Erie research developments in spudder design — an 85-ft. servicing derrick as special equipment for the 48-L spudder. Based on careful study of field needs, the new derrick provides added height without sacrifice of portability for fast, profitable clean-out, rod and tubing, or other servicing work. Its welded steel structure is similar to the 48-L's standard 60-ft. derrick which is unexcelled for strength and durability. Check the new derrick's outstanding features:

AMPLE HEIGHT
Plenty of lifting space to pull 30-ft. doubles.

BIG CAPACITY
Handles up to 60,000 pounds of tubing.

STRONG STRUCTURAL DESIGN
12-in. lower section channels, 11-in. upper section channels. Upper section is made of laced angle construction.

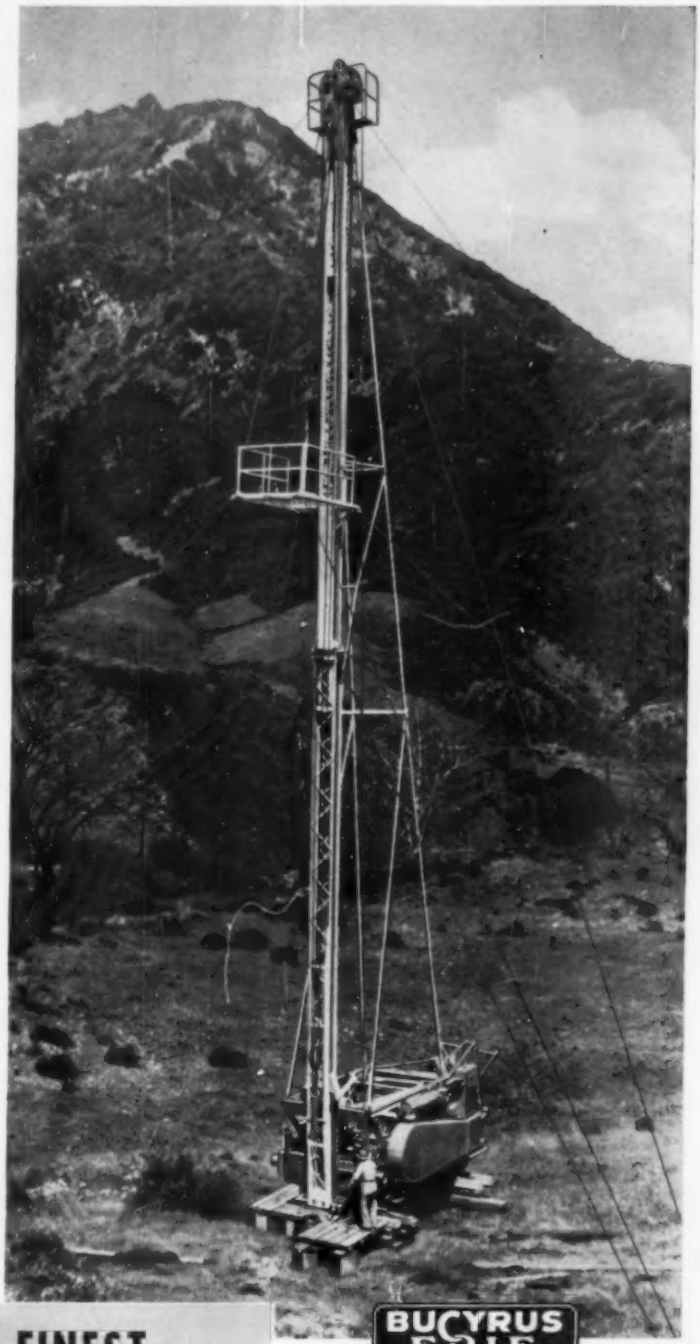
SIMPLE DESIGN
Telescoping 2-section derrick is power lowered, lays down over spudder for fast road travel.

CONVENIENT TUBING RACK
A fingerboard for racking well tubing is arranged to hold a total of 7,920 feet in 60-ft. stands.

EASY FIELD ERECTION
Power-raised with built-in oversize derrick hoist drum using 4-part hoisting line. When fully extended, guy lines can be set quickly — four each from the lower section, the fingerboard, and the top of derrick respectively.

This new-type derrick is available for 48-L s already in the field, or it may be ordered with a new machine in place of the standard derrick. Write today for complete details.

34556

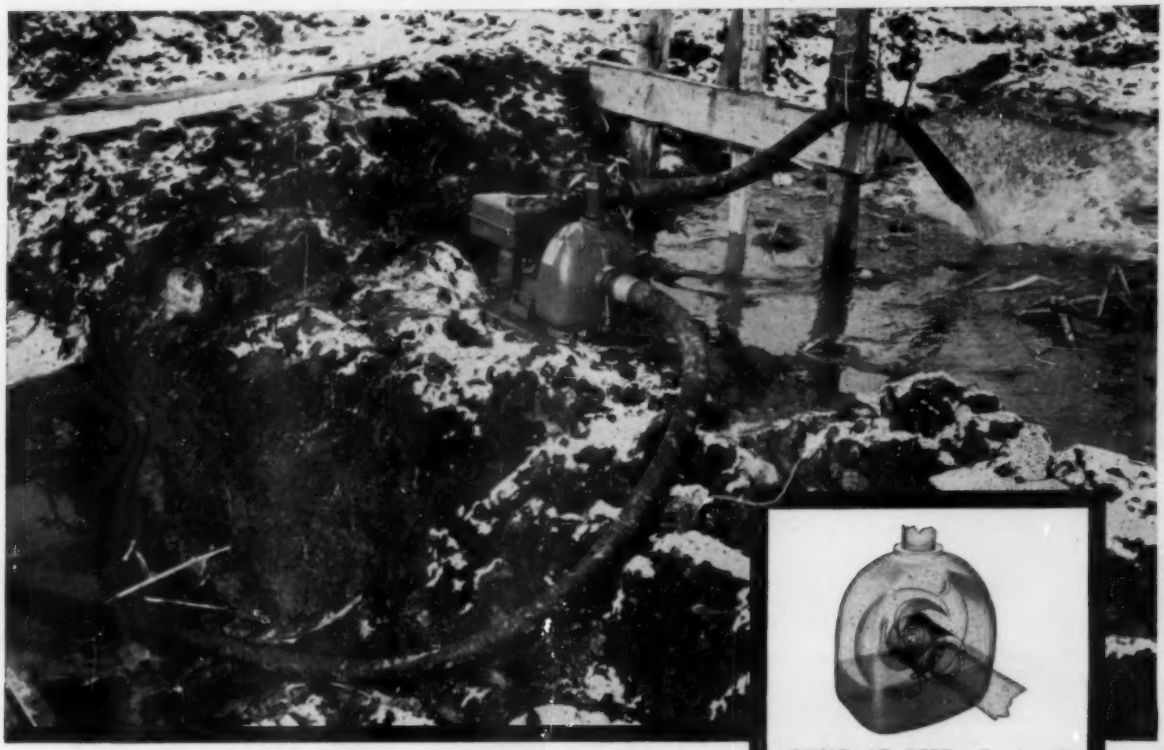


FIRST with the FINEST in Spudders

BUCYRUS ERIE

SOUTH MILWAUKEE, WISCONSIN

See the New Gorman-Rupp "80 Series" Pumps at Your Nearest Distributor!



SHOW STEALER!

Here's an exciting new line of Gorman-Rupp centrifugal pumps that prime . . . with important features never before offered to pump users. Straight-in suction! No check valve! These pumps never fail, never quit. Nor will solids foul them*.

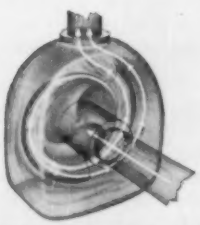
The new Gorman-Rupp design delivers pumped liquid direct to the eye of the impeller, increasing capacity, efficiency and lift. Simpler. Lighter in weight. Fewer parts. Sizes 1½", 2" and 3".

Featured in a high-tower priming demonstration at the Road Show in Chicago!

*Provided standard equipment supplied with pump is used.

PUMP AT REST—Captured liquid retained for priming. Note absence of the usual check valve.

PRIMING ACTION—Entrained air (B) escapes at (A) to be discharged. Priming liquid returns (C) to entrain more air.



PUMPING ACTION—Straight-in suction voids entrance restrictions. Water enters direct to the eye of the impeller.

THE GORMAN-RUPP COMPANY

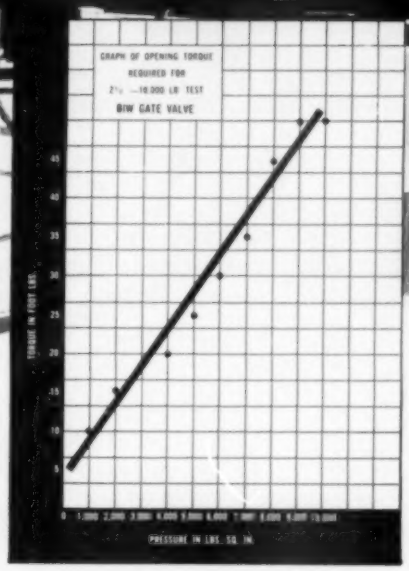
305 Bowman Street • Mansfield, Ohio

Mid-Continent & Gulf Coast Oilfield Representative

HENRY H. PARIS DISTRIBUTOR, INC.

1125 Rothwell Street, Houston, Texas

No Grunt, No Cheater, No Strain



BIW non-lubricated gate valves

These are the valves that always open and close easily, and without the expense of periodic maintenance. These are the valves that are always *ready* to open or to close easily. The graph shows the low torque required for operation *under pressure.*

The BIW non-lubricated gate valve frees you from the problems of maintenance. Once in, you can forget them. You can be sure that the tight metal-to-metal seat will hold. You can depend on the simplified design to give you years of trouble-free-service. More than 35,000 BIW valves in the field are doing their best right now. Get the best in maintenance-free, trouble-free valves for your wells.

ALCO specialists are available to show you the BIW Valve and the entire BIW Christmas tree. Or write ALCO Products, Inc., Petroleum Industry Equipment Division, Dept. BV-3, Bank of the Southwest Building, Houston, Texas.

ALCO

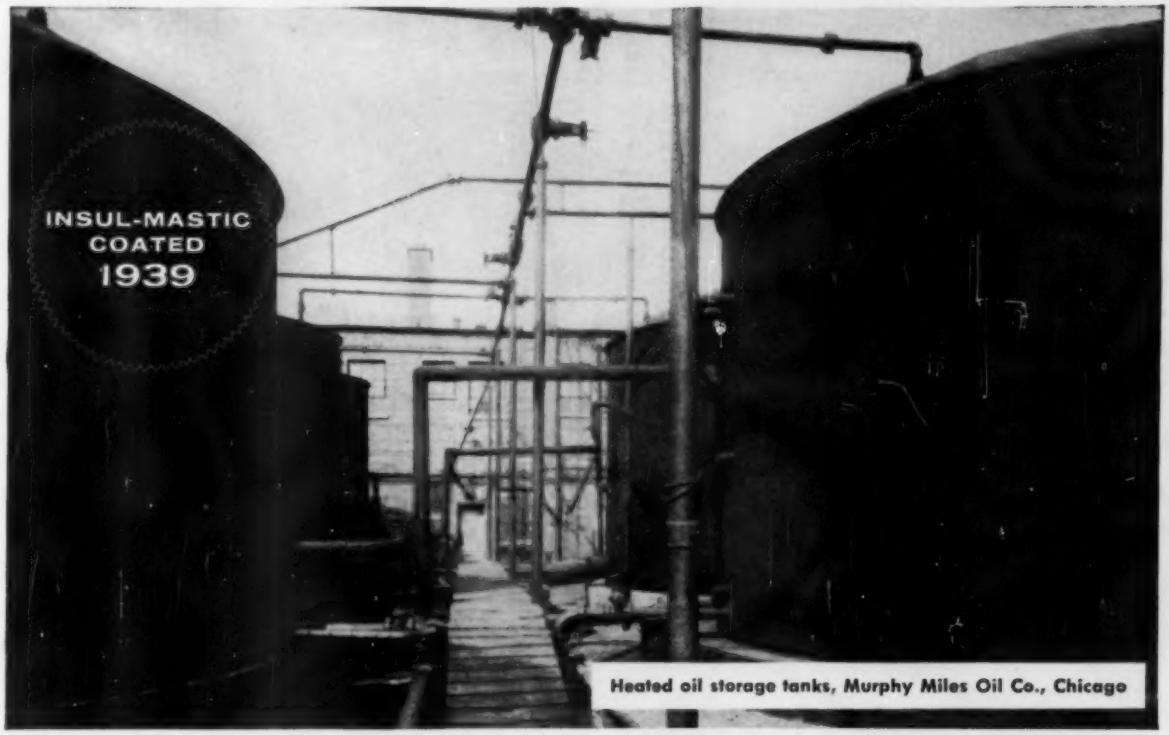
ALCO PRODUCTS, INC.

NEW YORK

Sales Offices in Principal Cities

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment

Proof again—the best costs you less!

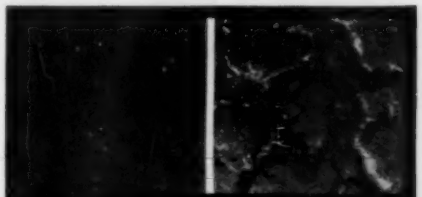


Heated oil storage tanks, Murphy Miles Oil Co., Chicago

17 Years without maintenance for these *Insul-Mastic* coated tanks

Ordinary asphaltic coatings can't possibly stand the test of years like Insul-Mastic "Gilsonite" coatings — and you can't ever be sure ordinary coatings are protecting against metal damage, or merely hiding it.

Understandably, Insul-Mastic costs a little more initially, but you can't find a better system for preventing corrosion, sealing out moisture, vapor sealing or handling the many specialized insulating requirements of industry. The proof is in the hundreds of installations like Murphy Miles Oil Co. where Insul-Mastic coatings continue to give the same *complete* protection they gave back in 1939. Your Insul-Mastic Representative will provide complete details without obligation.



6 year exposure shows Insul-Mastic (left) unchanged. Ordinary mastic (right) shows shrinkage and deterioration that breeds metal damage.

GILSONITE
makes the difference

Gilsonite is one of the most resistant of all materials used for protective coatings. It is composed of highly complex hydrocarbons saturated to the limit of their capacity, not susceptible to displacement by other elements nor to combination with acids and alkalis, nor to oxidation for many years by exposure to the atmosphere. It is better than 99.5% pure, being entirely free from volatiles and other short-lived impurities. *For years Insul-Mastic Gilsonite content has been far greater than any other mastic. Many contain no Gilsonite!*

MAIL THIS COUPON TODAY TO:
INSUL-MASTIC CORPORATION OF AMERICA
7760 West 61st Place, Summit, Illinois
☐ Send information ☐ Have Representative call

Name_____ Title_____
Company_____
Address_____
City_____ State_____

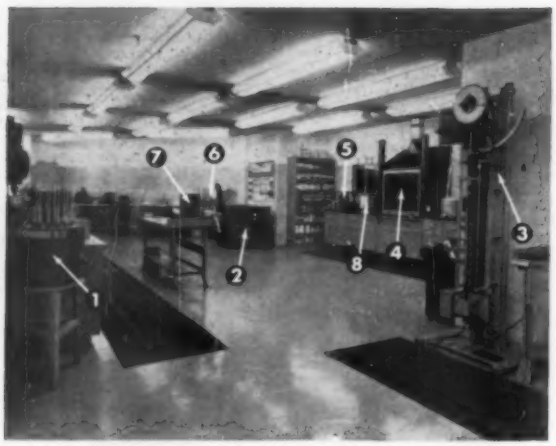
Think first of the coatings that last!

Insul-Mastic
CORPORATION OF AMERICA
7760 WEST 61st PLACE SUMMIT, ILLINOIS

1. Insulation Test Equipment
2. Dielectric Test Equipment

1. Sub-Zero Cabinet
2. Air Permeability Apparatus
3. Zipper Seal Test Tank
4. Analytical Balance

MALONEY MAINTAINS PRECISE CONTROL



1. Comet Aging Block
2. Sub-Zero Cabinet
3. Scott Tester
4. Oil Immersion Apparatus
5. Gravimeter
6. Air Permeability Apparatus
7. High Powered Microscope
8. Drying Oven

These pictures of our newly expanded Research and Development Laboratory will give you some idea of why F. H. Maloney Company for 25 years has had the reputation for "Precision in Rubber — Metals — Plastics." It is the largest and most complete laboratory of its type in the Southwest. Mr. A. S. (Tony) Girala, Chief Development Engineer, who has been with our organization for 20 years, heads up this laboratory and a staff of experienced technicians and research chemists.

This Laboratory is available to our customers for Testing, Research, Development, and Specification-compounding.

While this Laboratory is completely air-conditioned and all testing is done under controlled atmospheric conditions, adjoining this Laboratory is a complete Pilot Plant capable of producing specification rubber under atmospheric conditions, duplicating the conditions that prevail in our rubber manufacturing plants. This Pilot Plant is also under the direct supervision of Mr. Girala.

"Something from the Irishman"

F. H. MALONEY Company

Houston, Texas

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LOS ANGELES • TULSA • OLEAN, N. Y.

SINCE 1932—PRECISION IN RUBBER—METAL—PLASTICS

They Say—

"Oil Hits Back!" . . .

. . . Among our best

"Without doubt the best public relations article in The Oil and Gas Journal for a long time is 'Oil Hits Back!' I was delighted with it and am glad that you have taken such a positive attitude in hitting back.

"I am writing the Readers Service Department to get reprints. The more widespread such publicity, the better it will be for our industry.

"You have presented a masterly refutation of charges made against a great industry. More power to you!"

Dorsey Hager,
Consulting Geologist
Salt Lake City.

. . . Facts for politicians

"Please send us . . . copies of this section . . . we want to use them on some of our politicians and so-called 'statesmen' who keep talking through their hats. The issue seems useful to some of them as it is their means of keeping their names before the public."

Carleton Clymer,
Grove Valve & Regulator Co.
Denver, Colo.

. . . A.P.I. approves

". . . 'Oil Hits Back!' is a terrific piece . . . "

Philip C. Humphrey,
Oil Information Committee
American Petroleum Institute.

. . . Companies chime in

". . . When reprints are available . . . furnish this office with 500 copies . . ."

Mid-Continent Oil and
Gas Association.

". . . Please send us 9,000 copies of 'Oil Hits Back!' . . . "

Western Oil and
Gas Association.

". . . Would like to place order for 18,000 reprints of 'Oil Hits Back!' "

Lone Star Steel Co.

". . . Please send 200 copies of 'Oil Hits Back!' as soon as they are available . . . "

Sun Oil Co.

". . . Process immediately 2,000 'Strike Back' oil supplements . . . May

RUGGED...
but extremely SENSITIVE!

PARTLOW TEMPERATURE CONTROLS are built to withstand rough usage, but they're also extremely sensitive to slightest temperature changes. They'll take a lot of punishment without upsetting their accuracy and precision.

If your process requires precise temperature control in the –30°F to 1200°F range, you can do it better . . . and at lower cost . . . with Partlow Controls.

They're less complicated than thermocouples. Thick-walled capillaries and seamless tubing assure almost indefinite life. Elements can be replaced on the spot.

What's your control problem?

Tell it to Partlow!

THE PARTLOW CORP., Dept. G-457
New Hartford, N. Y.
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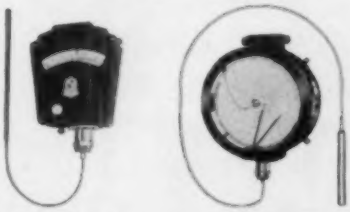
SEND FOR THIS FREE CONDENSED CATALOG



MODEL LS
Indicating Temperature Control

MODEL RS
Recording Temperature Control

partlow
the pioneer in mercury thermal controls

NO MATTER WHAT YOU MAKE, PARTLOW CONTROLS WILL HELP MAKE IT BETTER

It takes BOTH to make a tight BOLTED STEEL TANK...

MASTER-CRAFTED BY COLUMBIAN SINCE 1893

1. *Modern* techniques and materials

2. OLD FASHIONED Craftsmanship

Call Your Nearest COLUMBIAN Distributor

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O'Neill Tank Co., Inc.
Sterling, Colo.

KANSAS
O'Neill Tank Co., Inc.
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Great Bend, Kans.
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Hill City, Kans.

LOUISIANA
McGuffin Tank Co.
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Shreveport, La.

McClatchey Tank & Supply Service
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Lafayette, La.

NEW MEXICO
Allied Supply Co.
P. O. Box 217
Artesia, N. M.

American Tank & Steel Corp.
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Farmington, N. M.

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Gray-Brown Tank Co.
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Mapp Tank Co.
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Martin Tank Co.
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Corsicana, Texas
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Federal Tank Co., Inc.
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Texas Gulf Tank Co.
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Houston, Texas

Westex Tank Co.
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Odessa, Texas

Columbian Steel Tank Co.
(warehouse)
3705 McKinney Ave.
Houston, Texas

B. A. Box
P. O. Box 547
Beeville, Texas

Panhandle Steel Products Co.
P. O. Box 1191
Wichita Falls, Texas

Tank crews know best that the test of a Bolted Steel tank is: Does it "fit up"... Does it stay tight. Tank crews like Columbian Tanks because they do "fit up" better. Oil producers like Columbian Tanks because they do "stay tight." They stay tight because they fit better. That's why Columbian Tanks set the pace... ever since Columbian designed and made the *first* Bolted Steel Tanks. Meanwhile, modern research has developed new gasket materials, improved manufacturing methods, to make Columbian Tanks still easier to erect and to last longer. But modern machinery methods and materials alone are not enough. Old fashioned master-craftsmanship is still essential. At Columbian, quality control is never second to quantity production. That is why, tank after tank, you can always depend on master-crafted Columbians.

Want to know more about what makes tanks tight? Send for this most unusual handbook of valuable information and specifications. IT'S FREE!

COLUMBIAN STEEL TANK CO.
P. O. Box 4048-J Kansas City, Mo.

TANKS FOR THE WORLD

Reg. U.S. Pat. Off.

STEEL, Master-Crafted by Columbian... First for Lasting Strength

I take this opportunity to thank you . . . for an excellent presentation . . ."

V. F. Harrison,
Southern Minerals Corp.

(Editor's note: "Oil Hits Back!" from the March 18, 1957, Oil and Gas Journal, is a best seller. Over 65,000 reprints were ordered, processed, and distributed in the 2 weeks after its initial publication. A few of the many letters received by the Journal are shown above).

Bouquet for news letter

Dear Sir:

I want to congratulate you on your News Letter in the March 18, 1957 Journal. Something like this is very easy to read and gives one the high points of what is going on from an experienced observer; it should be very helpful to quite a few people in the oil industry.

I certainly hope that you continue to make it a part of your good publication.

Carle F. Sharp, manager
Domestic Production Dept.
Texas Gulf Coast region,
Atlantic Refining Co.
Houston.

Oil's best spokesmen

Dear Sir:

As you say in your editorial of March 18, "the industry's top brass must be its spokesmen—spokesmen for the whole industry, not just their own companies or their own segments." And it is equally necessary for the industry to "have one voice," as set forth in your editorial of February 25.

In fact, these two principles head the list, and the industry might as well forget there are any others for the time being.

Many an industry has gone around and around before the public with its opposition, and yet none today is as vulnerable to fresh attack as is oil. A battle with labor is almost standard operating procedure for some industries, and hardly an important one has escaped unwelcome governmental attention. But, with the possible exception of the air-transportation industry, the oil industry alone waves its internal squabbling under the public nose.

The American Association of Railroads and the O.I.C. are the spokesmen for two industries. Individual companies are the spokesmen for other industries. Clearly an industrial association is inherently ineffective as a spokesman. So long as the oil industry blinds itself to this fact it will be "hissed, kicked, and pushed around." And, if

As
tanker capacity
grows...
FIRE HAZARD increases!

New, larger tankers
now help meet the nation's
needs for a greater flow
of liquid fuels.
But as tonnage grows,
so does fire hazard... both in
the ships themselves and
in the docks that serve them.
If the big new tankers
have a place in your business,
be sure
your fire protection program
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For specific suggestions,
call National Foam.

NATIONAL FOAM System, Inc.
West Chester, Pa.

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The only company exclusively engaged in the design, development and manufacture of foam fire protection equipment and chemicals.

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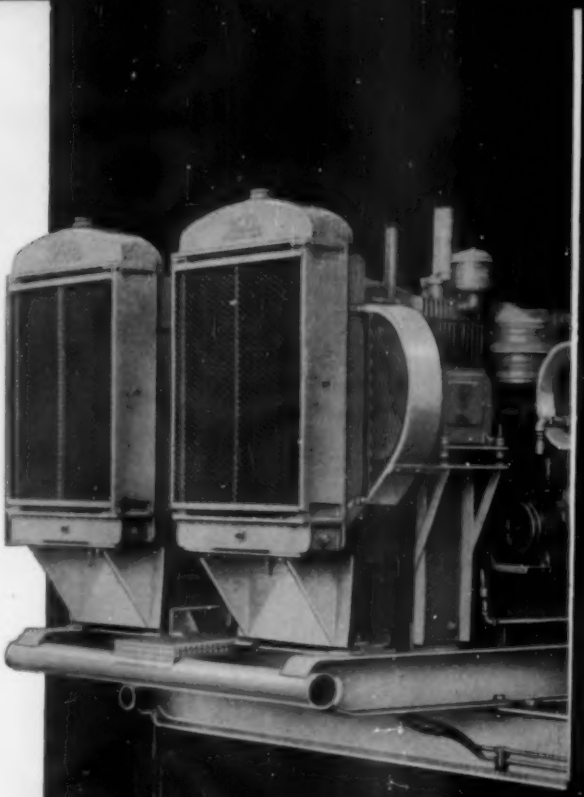
NEW ENGINEERING!

tailored to fit your needs

THE *NEW*

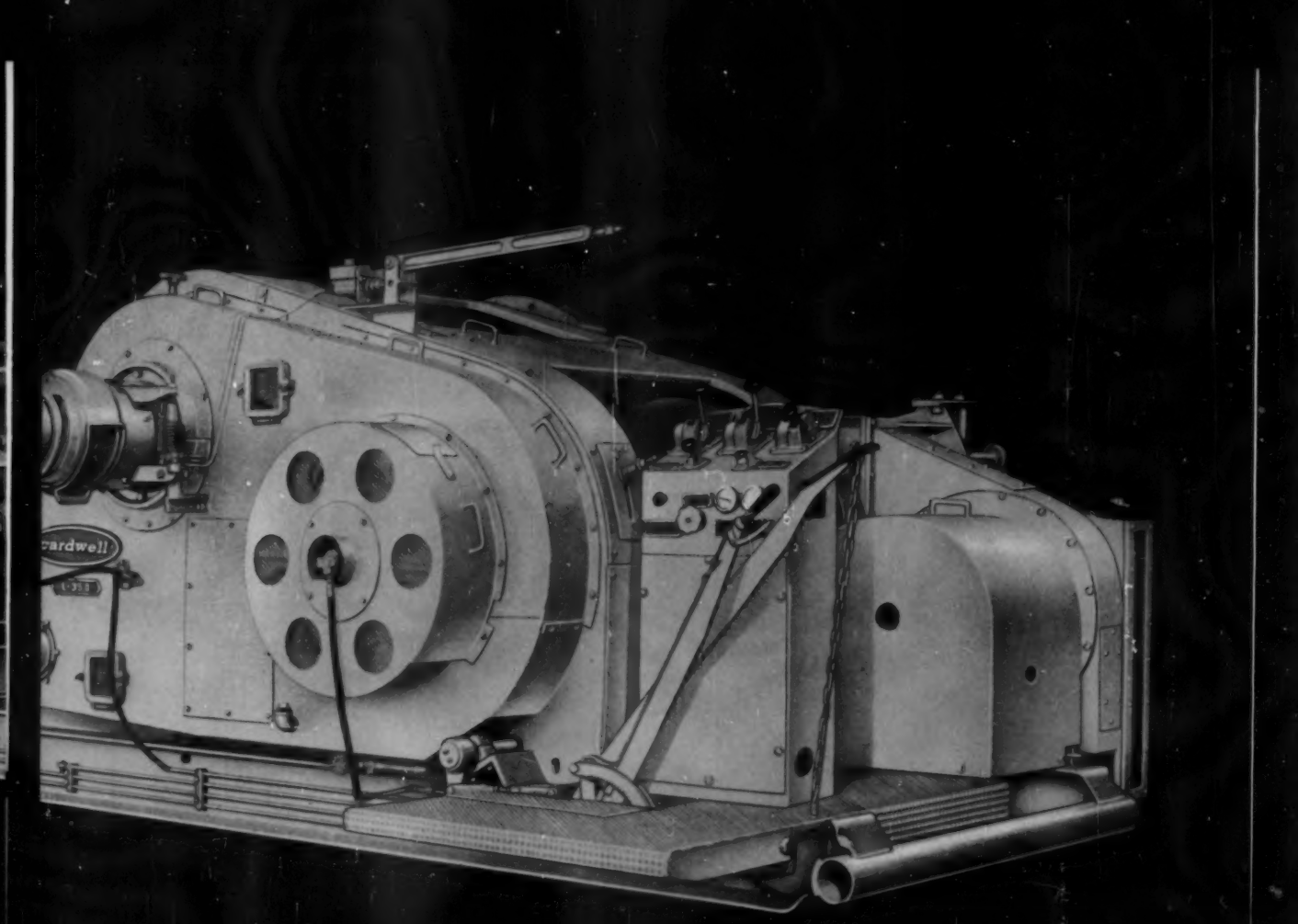
cardwell L-350



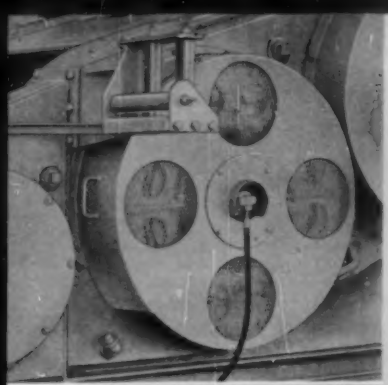
The new Cardwell L-350 is a compact single or twin engine draw works using plate frame construction to achieve a high strength-to-weight ratio. All drives are oil bath lubricated for longer chain life. Here's an extremely versatile unit that is readily adaptable to various trailer mountings as well as conventional skid masts. Single lever controls are centralized in a forward mounted control panel. The safety factor is increased by allowing the driller full view of all drilling operations. An optional sand line drum is offered that does not require any main frame changes. The Model L-350 has a nominal horsepower rating of 350.

Job-tailored Features

- PLATE-FRAME CONSTRUCTION for high strength-to-weight ratio.
- CHAIN DRIVES—all oil bath lubricated.
- SIMPLIFIED SINGLE LEVER CONTROLS for safe, convenient operation.
- FRICTION CLUTCHES — Fawick's newest design — exterior mounted.
- HYDROMATIC BRAKE (optional) 15-inch double rotor mounted with a separate Friction Engaging clutch.
- ROTARY BRAKE—Air Controlled—quickly and smoothly stops and holds rotary table.

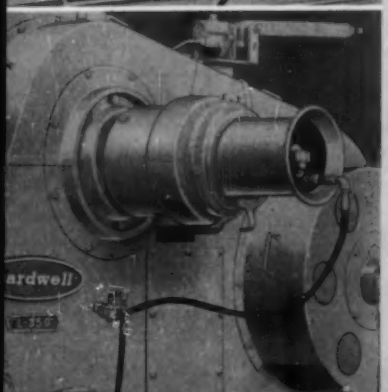


TORQUE CONVERTER DRAW WORKS



Externally mounted clutches

Maximum operating efficiency is provided by Fawick VC (ventilated type) clutches mounted in each end of a Double End Drum Drive.



Oil bath chain drives

Oil bath lubrication to all drives. This efficient oiling system assures positive lubrication and long life for all chain drives.

C-4-7

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A new name in pumping units

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built to outperform the best!

Before designing the new Aztec pumping unit, we studied the requirements of many oil producers. As a result, Aztec units combine *many important field-proven features* with the latest design principles developed through our own extensive manufacturing experience.

Standout features such as the rigidly braced, four-legged Samson Post, bronze bearings at saddle and equalizer, arc type hanger with vertical adjustment, herringbone gear reducer with positive bearing lubrication and roller bearings designed for over 100,000 hours B 10 life, help to make Aztec your best pumping unit buy.

Aztec units are available NOW in sizes up to 7,000 pounds API polished rod load capacity. Rapid expansion will soon make available a complete range of sizes of Aztec units. Ask your supply store for information and prices.

See the new Aztec pumping unit at your favorite supply store soon. Compare it, try it, and prove it's your best pumping unit buy.

AZTEC
MANUFACTURING CO.

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FORT WORTH, TEXAS

it continues in this blindness, it may find itself as regulated as the railroads."

Walter H. Amis, Jr.,
Dallas.

Double talk in S-11

"Advocates of S-11 have asserted that an oil company giving price assistance to its dealer during a price war should extend this assistance over a wide area. How wide this area should be is not defined, so we believe that the only practical effect of such an action would be to extend price wars and, thereby, injure dealers who, were previously unaffected. This has been the chief reason for our opposition to the bill.

". . . The phraseology which has led to most of the confusion over the bill's meaning and is likely, if adopted, to require years of litigation to be clearly understood, is contained in a clause which says that good faith meeting of a competitor's lower price shall be a defense for persons accused of price discrimination, except when the effect of the discrimination charged 'may be substantially to lessen competition or tend to create a monopoly.'

"Now no one in the oil industry or any other industry that I know of is in favor of monopoly in any form. The confusing phraseology is the part about 'substantially to lessen competition.' No one that I have talked to, including some very able lawyers, can say for sure what kind of situations would be required 'substantially to lessen competition.' "

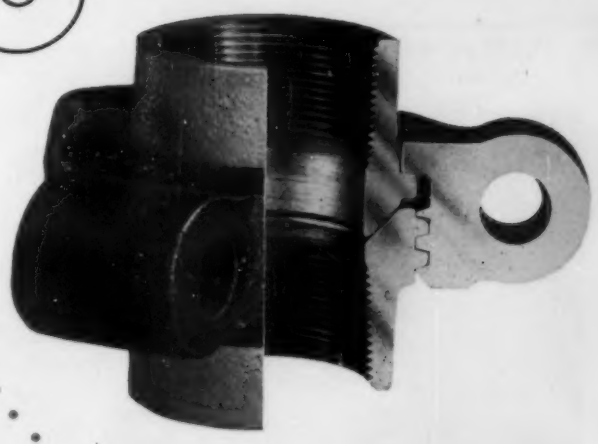
J. G. Jordan, vice president, marketing, Shell Oil Co., in a statement to a Senate subcommittee.

CALENDAR OF EVENTS

APRIL

2-4	Corrosion Control, fourth annual conference, sponsored by National Association of Corrosion Engineers and the University of Oklahoma College of Engineering, University of Oklahoma, Norman, Okla.
7-10	Petroleum Equipment Suppliers Association, annual convention, Palm Springs, Calif.
7-12	American Chemical Society, national meeting, Miami, Fla.
8-10	American Society of Mechanical Engineers, spring meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala.
8-11	American Gas Association, distribution conference, Houston.
9	American Institute of Chemical Engineers, Philadelphia - Wilmington section, University of Pennsylvania, conference on catalysis in practice, University Museum, Philadelphia.
9-11	American Welding Society, fifth an-

THE 3 MOST IMPORTANT FUNCTIONS OF A UNION



LEAK-PROOF SEALING—
EASY MAKE-UP AND BREAK-OUT—
LONG LIFE are basically the most important functions of a union. All are synonymous with Weco Unions.

Leak-proof sealing is the result of Weco's ball and cone seat that forms a metal-to-metal surface unequaled for positive sealing. Easy make-up and break-out is provided by Weco's precision machined Acme threads. The long life of Weco Unions comes from sturdier construction of sub ends and wing nuts that can take the toughest treatment a worker can hand them—and come back for more—month after month.

These time-and-money-saving functions make Weco your best union buy today. Get them at supply stores everywhere.

U-1-56

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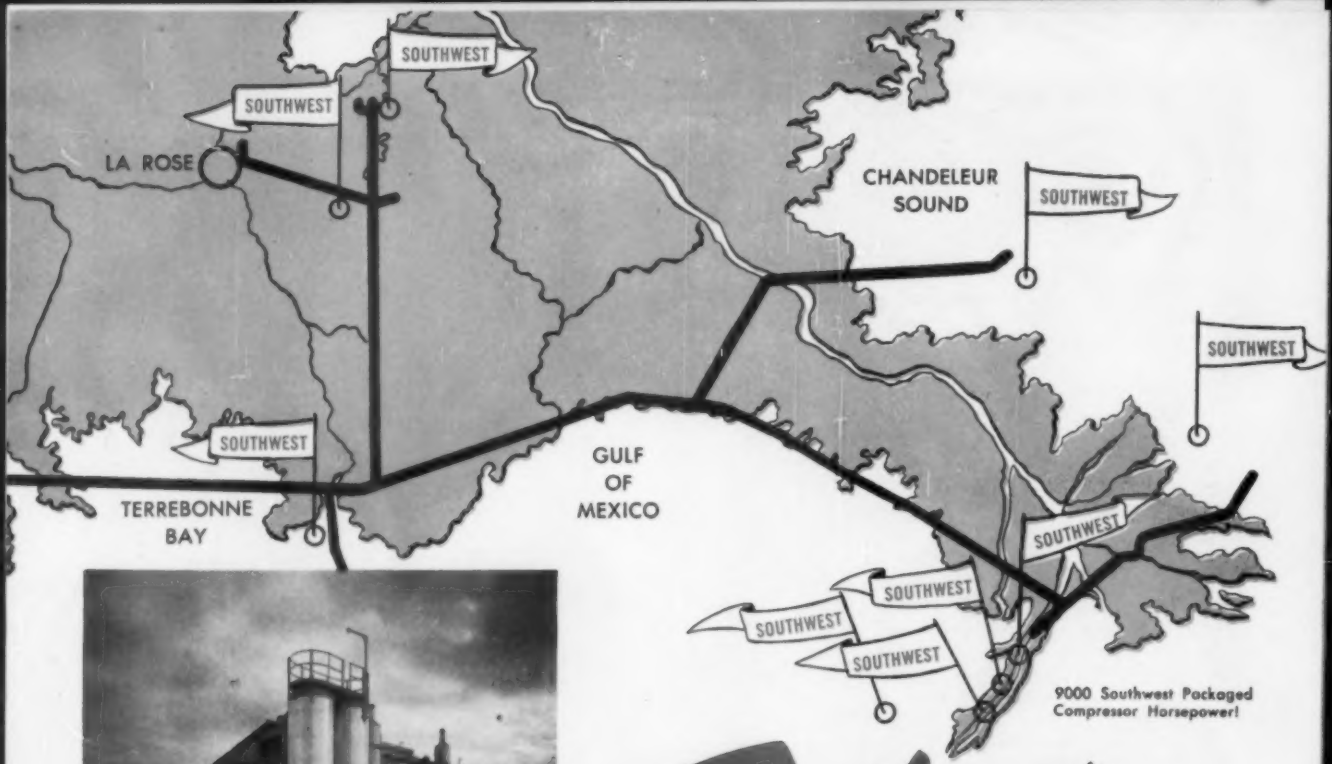

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PACKAGED GAS COMPRESSORS FEEDING "THE MUSKRAT LINE"

From the South Pass area of the Mississippi Delta west for almost 400 miles to Crowley, La., the Muskrat Line lies in swamps, bays, and marshes. Eighty per cent of the line lies underwater! To boost the pressure of gathering lines feeding into it, five majors have turned to Southwest Packaged Gas Compressor Plants. These Southwest units can be installed in any location to do any compressing job. These balanced units can be mounted on piling, concrete platforms, barges, or wherever necessary for most economical installation and operation.

Southwest plants are saving gas producers thousands of dollars in the rugged swamp country of South Louisiana through low installation and low operating costs. Available in sizes from 265 hp to 660 hp.

FOR GAS LIFT, GAS BOOSTER, PRESSURE MAINTENANCE AND SIMILAR PROJECTS.

SOUTHWEST INDUSTRIES, INC.

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nual welding show, Convention Hall Philadelphia.

10-12 American Petroleum Institute, Mid Continent district production division meeting, Mayo Hotel, Tulsa.

11 Illinois Oil and Gas Association, twelfth annual meeting, Mount Vernon, Ill.

11-12 West Texas Oil Lifting Short Course, Texas Technological College, Lubbock, Tex.

11-13 Institute of Radio Engineers, ninth annual southwestern I.R.E. conference and electronics show, sponsored by Houston section, Shamrock Hilton, Houston.

11-13 Institute of Radio Engineers, second national simulation conference, sponsored by Professional Group on Electronic Computers, Shamrock Hilton Hotel, Houston.

11-13 American Institute of Mining, Metallurgical, and Petroleum Engineers Pacific Northwest Regional Conference, Portland, Ore.

16-18 Petroleum Industry Electrical Association annual meeting, Shamrock Hilton Hotel, Houston.

16-18 Petroleum Electric Suppliers Association, Shamrock Hilton Hotel, Houston.

16-18 Southwestern Gas Measurement Short Course, University of Oklahoma, Norman, Okla.

16-18 National Petroleum Association, fifty-fourth semiannual meeting, Cleveland.

17-18 Western Oil and Gas Association, annual Southern California safety conference, Pacific Coast club, Long Beach.

18-19 Texas Petroleum Research Committee and Permian Basin Section of American Institute of Mining, Metallurgical, and Petroleum Engineers, tenth annual oil-recovery conference, Midland, Tex.

22-25 Canadian Institute of Mining and Metallurgy, annual general meeting, Chateau Laurier, Ottawa.

24-26 Natural Gasoline Association of America, thirty-sixth annual convention, Rice Hotel, Houston.

24-26 American Petroleum Institute, Rocky Mountain district production division meeting, Gladstone, Townsend, and Henning Hotels, Casper, Wyo.

25-27 Appalachian Geological Society, Kentucky Geological Society, joint field conference, southeastern Kentucky.

25-27 American Association of Petroleum Landmen, third annual convention, Hilton Hotel, San Antonio, Tex.

27 American Institute of Chemical Engineers, Oklahoma state meeting, Bartlesville, Okla.

28-30 Independent Petroleum Association of America, midyear meeting, Buena Vista Hotel, Biloxi, Miss.

29-30 Automatic Control in the Petroleum and Chemical Industries, conference sponsored by the University of Oklahoma, extension study center, University of Oklahoma, Norman, Okla.

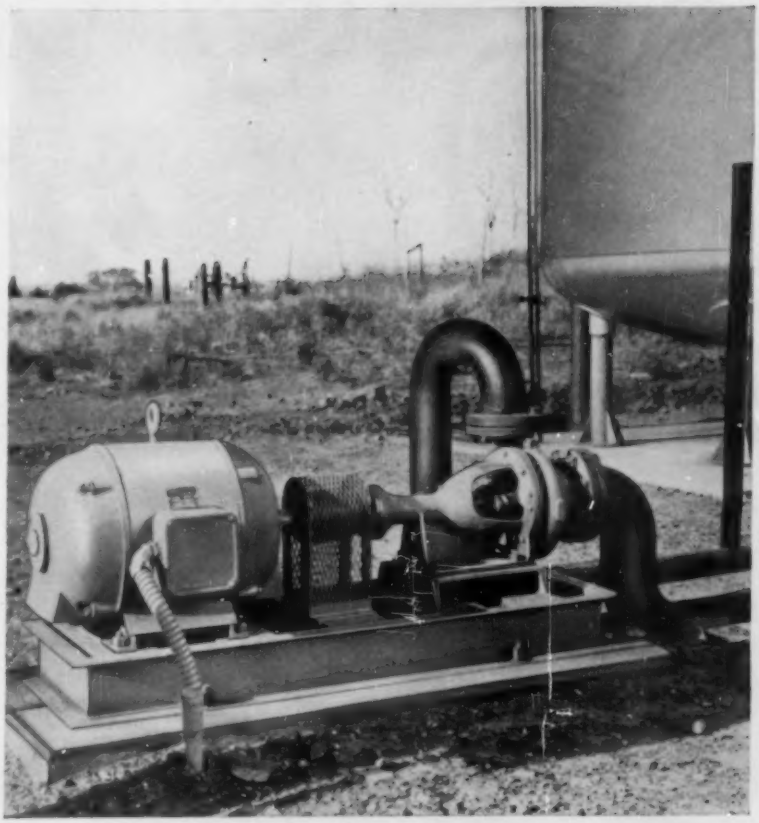
29-May 1 Southern Gas Association, annual convention, New Orleans.

MAY

1-3 American Petroleum Institute, Division of Production, eastern district meeting, William Penn Hotel, Pittsburgh.

6-8 American Petroleum Institute, annual pipeline conference, Cleveland Hotel, Cleveland.

6-8 American Geophysical Union, thirty-eighth annual meeting, National Acad-



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Ampco Pumps are ideal for salt-water disposal and flooding operations:

- *Transfer service*
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- *Pumping through filters*
- *Back-flushing filters*
- *Delivery of treated water*

It's an AMPCO . . . made from aluminum bronze that contains no zinc.

Ampco Pumps resist corrosion, erosion, abrasion, cavitation-pitting, and dezincification. They are made from Ampco alloys engineered specifically to resist salt water corrosion.

Durability isn't the only advantage of Ampco Pumps. They have high efficiency . . . up to 85%. You pay considerably less for power.

Ampco Pumps are available in more than 100 different combinations, with speeds from 1750 to 3500 rpm; capacities to 600 gpm; heads to 300 feet.

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1. **A CONSERVATIVE MATERIALS FACTOR OF 1.0**—Fluor-Western Cooling Tower Gears are rated in accordance with American Gear Manufacturer's Association standards calling for a materials factor of 1.0 for gears of a Rockwell "C" 60. *Less conservative* methods of rating permit the use of a materials factor of greater than 1.0 which, with all other factors being equal, will result in the size of the ring and pinion gear unit being reduced in the same proportion that the materials factor used is greater than 1.0.
2. **A STANDARD SERVICE FACTOR OF 1.5**—Fluor-Western Gears have a standard AGMA rated service factor of 1.5 which means that by *standardizing* on this service factor, Fluor customers are assured that the gear unit is designed for continual operation using electric motors or turbines.
3. **STRADDLE MOUNTED PINION**—Fluor-Western gear units feature a straddle mounted pinion. Far superior to the common cantilever type mounting, this Fluor-Western method of supporting the pinion between two rugged, long life bearings minimizes deflection, insures a smooth wear pattern across the gear teeth with quieter operation.
4. **SPIRAL BEVEL GEARS CASE-HARDENED** to 60 Rockwell "C" hardness calling for a materials factor of 1.0... gives longer service life than worm gears or flame-hardened bevel gears.
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6. **A 100,000 HOUR MINIMUM B-10 BEARING LIFE**—The majority of bearings have a B-10 life in excess of 100,000 hours. In many instances, bearing life can be considered infinite.
7. **2 NEOPRENE SEALS** mounted back-to-back on the input shaft give *positive* protection against moisture leakage.

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	emy of Sciences, Washington, D. C.
7	American Gas Association, committee on underground storage, operating section, Mark Hopkins Hotel, San Francisco.
8-10	Canadian Institute of Mining and Metallurgy, eighth annual convention, petroleum and natural-gas division, Macdonald Hotel, Edmonton.
8-10	American Gas Association, Pacific Coast Gas Association, gas supply, transmission, and storage conference, Mark Hopkins Hotel, San Francisco.
9	Panhandle Producers and Royalty Owners Association, annual meeting, Herring Hotel, Amarillo, Tex.
9-10	Fourth annual heat-transfer conference, Oklahoma A. & M. College, Student Union Building, Stillwater, Okla.
9-10	Symposium on use of surface active agents in water flooding, Pennsylvania State University, department of petroleum and natural gas, State College, Pa.
12-15	Liquefied Petroleum Gas Association, annual meeting, Conrad Hilton Hotel, Chicago.
13-15	Industrial Waste Conference, sponsored by Purdue University, Purdue Memorial Union Building, Lafayette, Ind.
13-16	American Petroleum Institute, division of refining, midyear meeting, Sheraton Hotel, Philadelphia.
14-16	Industrial Nuclear Technology Conference, sponsored by Armour Research Foundation of Illinois Institute of Technology and Nucleonics Magazine, Museum of Science and Industry, Chicago.
16-17	American Right of Way Association, third annual national seminar, Conrad Hilton Hotel, Chicago.
16-17	American Petroleum Institute, division of production, Pacific Coast district meeting, Hotel Biltmore, Los Angeles.
16-18	Geological Society of America, southeastern section, annual meeting, Morgantown, W. Va.
19-22	Texas Independent Producers and Royalty Owners Association, Galvez and Buccaneer Hotel, Galveston, Tex.
20-22	American Petroleum Institute, division of transportation, central committee on transportation by water and tanker corrosion symposium, San Francisco.
20-22	American Gas Association, chemical, engineering, and manufactured gas production conference, Balmoral Hotel, Bal Harbour, Fla.
20-23	American Society of Mechanical Engineers, twenty-ninth annual conference and exhibit of the oil and gas power division, Kentucky Hotel, Louisville, Ky.
21-23	Pennsylvania Gas Association, annual meeting, Pocono Manor Inn, Pocono Manor, Pa.
23-24	Kentucky Oil and Gas Association, annual membership meeting, Hotel Phoenix, Lexington, Ky.
23-24	American Institute of Mining, Metallurgical, and Petroleum Engineers, third annual joint meeting, Rocky Mountain petroleum sections, Northern Hotel, Billings, Mont.
23-24	Western Petroleum Refiners Association, southwest regional technical-industrial relations meeting, Hotel Paso del Norte, El Paso, Tex.
27-29	Rocky Mountain Oil and Gas Association, twelfth annual convention, Denver.
29-31	Annual short course in gas technology, Texas College of Arts and Industries, Kingsville, Tex.

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Safety Designed...
with comfort in mind!

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McDONALD
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the original aluminum hat

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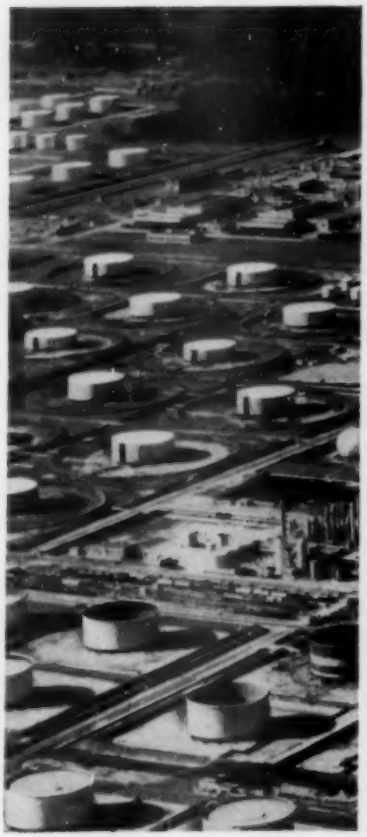

Here at Lake Charles, Louisiana, Petroleum Chemicals, Inc. will expand its petrochemical facilities with the addition of a butyl rubber plant — to be built by Foster Wheeler.

With an initial capacity of 30,000 tons per year, this $17,000,000 plant will be the first one built since the war and its operation will increase the country's total butyl rubber capacity by about one third. This new plant will obtain its raw materials from the hydrocarbon streams available at the Lake Charles refineries of Cities Service and Continental Oil Companies, joint owners of Petroleum Chemicals, Inc.

Foster Wheeler is also building a 300 ton/day ammonia synthesis plant at the same site.

This is another example of how Foster Wheeler's design, engineering and construction experience is helping to meet the exact requirements of petroleum, chemical and petrochemical processing plants the world over.

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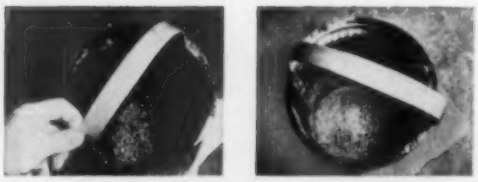
RESIDUAL FUEL

Du Pont additive proves outstanding as a dispersant, cleans sludge-laden tanks, keeps burner nozzles, filters and strainers clean



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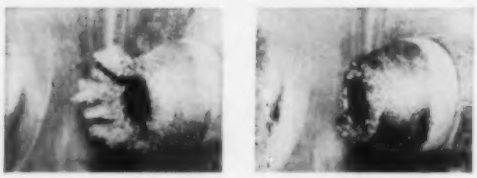

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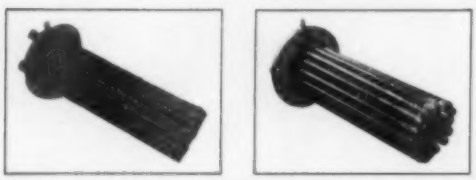
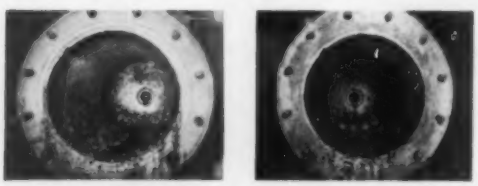


PREHEATER TUBE-FOULING . . . solved by FOA-2



PREHEATER-SHELL-FOULING . . . solved by FOA-2

Du Pont Fuel Oil Additive No. 2 has been proved a highly efficient sludge dispersant for residual fuels. In every test, the additive has succeeded where other—and often much more costly—methods have failed. Our own experience, in Du Pont manufacturing plants, has repeatedly confirmed these findings.

FOA-2 has cleaned many tanks too sludge-laden for operation, and the dispersed sludge has been burned without furnace shutdown. After these cleanings, the continued use of FOA-2, in small concentrations, has *kept* nozzles, filters and strainers clean, practically eliminating fouling and reducing the need for expensive tank cleanings to an absolute minimum. Being nonmetallic, FOA-2 itself burns completely, leaving no ash.

Users get all this protection, all this insurance against operation failure, with only a minute quantity of FOA-2 per barrel of oil. Storage space is kept available for storage of residual fuel—*not sludge.*

The Du Pont Petroleum Laboratory recently issued a technical memorandum (No. 317, dated January 1957). It reports in detail ten typical case histories of residual fuel problems solved with FOA-2 . . . in a refinery, and in large industrial plants, an apartment house, a power station and a country club.

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TULSA, OKLAHOMA

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JOURNALLY SPEAKING . . .

Psychoceramics

TO all rockhounds, doodlebuggers, fossil fanciers, and kindred brethren of the oil-finding fraternity, this annual exploration issue of the Big Yellow Book is dedicated.

You have made great strides in the application of scientific principles and instruments to the hazardous business of finding oil. Or have you? There are those who doubt it.

The Journal gets many letters from people who have marvelous new devices for finding oil, but you hidebound, tradition-steeped geologists won't even give them a tumble. As one man wrote:

"One must learn to see through geology and not at it. Unless geologists have a beautifully drawn map they don't consider it a trap. The map is the trap."

On the other hand, there's a man up in Quebec who complains that geologists don't put enough faith in maps. He has a method of applying formulas and projections to official USGS maps, and from where he sits he has already located several multizone oil fields. But nobody is interested enough to lease and drill them.

Another correspondent complains bitterly that oil companies refuse to make use of his service because "geologists and petroleum engineers belittle anything that does not originate from them. They condemn before investigating. By scientific methods and radioactive instruments we explore the earth's deep stratas for possible gas and oil-bearing zones and any strata which gives us the familiar signal is checked with signal absorbers and special techniques for possible oil or gas content or both. We also obtain useful data from other signals, which is the basis for definite interpretation, and by mathematical methods and data compilation we arrive at the approximate measurement of each zone's thickness."

Then there's a man in California who has a method he calls "dowsing to electronics." With this method he has already told the drillers of several dry holes how they missed big traps by just a few feet. He volunteered this much information:

"I will state that my electronic device operates 100 per cent electronically. With a special meter that creates a frequency of gas or oil, respectively, it is connected to a special built high frequency agitator that agitates my wire from a 6-volt battery, that gives me 25 cycles per second. In other words, it is a sonic wave and in 3 minutes I get about 5,000 ft. depth, and this repeats itself on the same cycle movement within the same time for a double check."

Still another: "After many years of scientific investigation and the use of many instruments I have finally settled upon one that is very good in setting wells for the finding of oil and gas. It is very positive. In developing this instrumentation I have found a way of getting away from the subconscious. One of the troubles in the science department has been with people who thought they had it all and would not learn. I took over myself and have now solved it to my satisfaction to set wells."

Even statistical proof doesn't help a lone-wolf inventor. One wrote: "We have developed an instrument with which we have checked over 1,400 holes before drilling, and missed only 98 times. What is beyond our comprehension is the utter lack of interest on the part of those who are charged with the responsibility of finding oil. We can locate and define the limits of hydrocarbon deposits for one-tenth of what it normally costs them now. Yet, no interest."

Women are in this business, too. One lady wrote: "I have a doodlebug and pick up rays from oil, gas, and salt water, and for the past 3 years have been experimenting, making and recording my tests, which are truly amazing in their accuracy. I read straight down from where I am standing, or riding in an automobile, plane, train, or boat. Have checked with a man using a Buck Rogers Scintillometer, and I read just the reverse. I get my big gyrations where the big wells are."

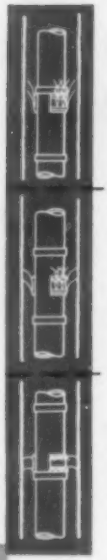
Now you orthodox oil-finders may relegate all such ideas to the science of psychoceramics, which is the study of crackpots. But are you sure you aren't overlooking some good bets? Geologists, geophysicists, and paleontologists were all considered crackpots at one time, you know.

—Henry D. Ralph.

HERE'S WHAT BAKER

Controlled SCRATCHING

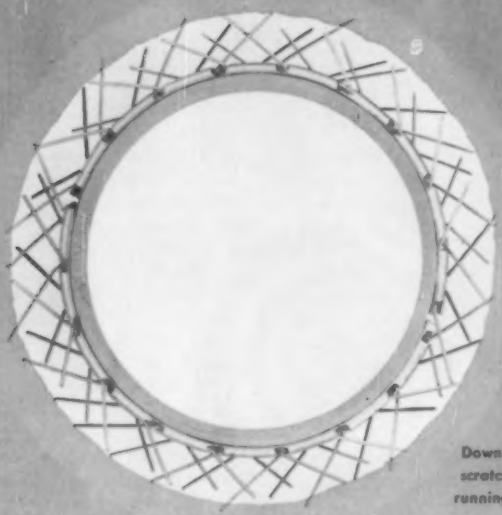
CAN DO FOR YOU!



When running in the casing string . . . the scratcher wires pass readily through sections which are *not* to be cemented, without damaging the vital filter cake.

When lifting the casing out of the slips . . . the scratcher wires do not attack the mud cake because the entire scratcher assembly remains stationary due to the three-foot interval between stop rings.

Only when the "scratching operation" is begun . . . by raising the casing a distance greater than the spacing between the stop rings, do the scratcher wires open outward and start to remove the mud cake.

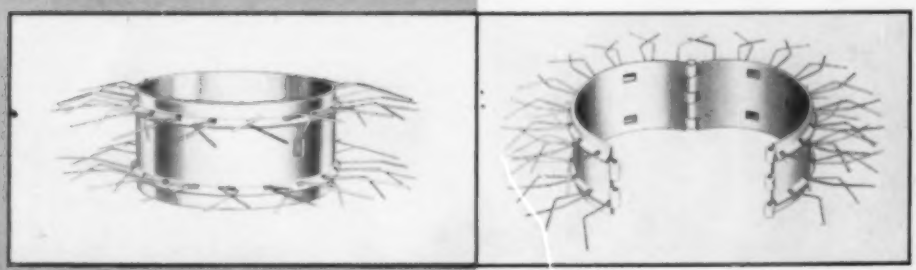


Down view shows scratcher wires in running-in position.

BAKER "Controlled Scratching" means effective removal of the mud cake, but ONLY in the areas to be cemented, where the original formation is exposed for better bonding of the cement.—The expensive filter cake—vital to the successful completion of your wells—is left virtually undisturbed in ALL areas outside of the cementing area. The strong "double-shell" construction, and the "fold-back" wires permit the scratchers to arrive *at the cementing point* in *good operating condition*, and then the overlapping wires effectively remove the mud cake over the 360-degree surface of the well bore.

Available with 4½-inch long (C-45) scratcher wires, or 2½-inch long (C-25) wires, one exactly right for your specific casing program. Contact the Baker representative in your area for helpful recommendations.

Baker Model "C" SOLID RING Wall Scratchers, Product No. 901-C, are merely slipped over the casing and positioned between two properly spaced stop rings.



Baker Model "C" HINGE-LOK Wall Scratchers, Product No. 900-C, are closed around the casing and the hinge is locked with a special knurled closing pin.

BAKER | **WALL SCRATCHERS**

BAKER OIL TOOLS, INC. HOUSTON • LOS ANGELES • NEW YORK

Geology can't answer the 64,000-well question

GEOLOGISTS are a little disappointed that the A.P.I. reserve figures didn't show larger 1956 additions to crude reserves.

They thought they discovered more oil than that. Probably they did. The official figures are "proved and recoverable" reserves—traditionally conservative as to new fields. The answer will come later as development wells are drilled.

Our biggest increases in established reserves always come through development drilling. If drilling is not maintained, the ratio of reserves to production will soon decline rapidly.

BUT WE'RE FALLING BEHIND in drilling. To maintain the reserves ratio we should have drilled 58,600 wells last year. We drilled only 58,160. And liquid reserves fell from 13.5 times production in 1954 to 12.5 in 1956.

This year we should drill 61,500 wells. Operators scheduled only 60,000. And it looks as though they may not make that. First-quarter completions are nearly 500 wells below last year—700 short in development wells.

The 64,000-well question comes next year. The expert forecasters say that's the number of wells we should drill in 1958 to maintain our position. That will be the key year. If we can't come close to the target by then, it will be most difficult to catch up with the anticipated need. Then our ratio of crude reserves to annual production will really be on the skids.

Geologists and wildcatters are confident they can keep finding new oil for many years to come. Granting that they can, they can't assure the follow-up drilling so essential to maintaining proved and recoverable reserves.

Wildcatting and new discoveries appear to be at satisfactory levels. But the bulk of the needed 64,000 wells must be development wells. And it takes more than good places to drill to foster development drilling.

It takes incentives and a favorable economic climate.

REASONS WHY DRILLING LAGS are many. They include tight money, rising costs, fear that the crude-price raise won't stick, political attacks on the industry, threats to the depletion percentage.

The biggest reason is the excess of producing capacity above demand for domestic crude—generally attributed to imports. But unless development drilling is maintained, this producibility will decline rapidly with the increase in consumption that lies ahead.

If, through lack of incentives or any reason, we let development work lag too far it may be impossible to catch up with the drilling schedule needed to maintain both producing capacity and a safe margin of reserves—a schedule that calls for 64,000 wells next year.

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FOR EVERY OIL-FIELD NEED

DUAL ADVANTAGE

Old-timers well remember 'INCOR' 24-Hour Cement, and with good reason. Because 'Incor' has been used with noteworthy success in cementing thousands of wells, invariably reducing the cost of "waiting on cement," saving lost rig-time, providing strong, tight, long-lasting shut-offs.

Now 'INCOR' SULPHATE RESISTANT CEMENT provides this dual additional advantage: (1) Protection against sulphate action, where this property is needed, and (2) greater yield per sack of cement, resulting in lower cost per cubic foot of slurry back of the casing, lighter slurries for better circulation, with dependable high early strengths and added protection. Manifold advantages, at the outset, and through the years.

There is a Lone Star Cement for every Oil Field requirement: 'INCOR'*, America's FIRST High-Early Sulphate-Resistant Cement . . . 'STARCOR'* Slow-Setting Oil Well cement... 'TEXCOR'* Deep Oil Well Cement... LONE STAR Cement, standard of highest quality for half a century.

*Reg. U.S. Pat. Off.

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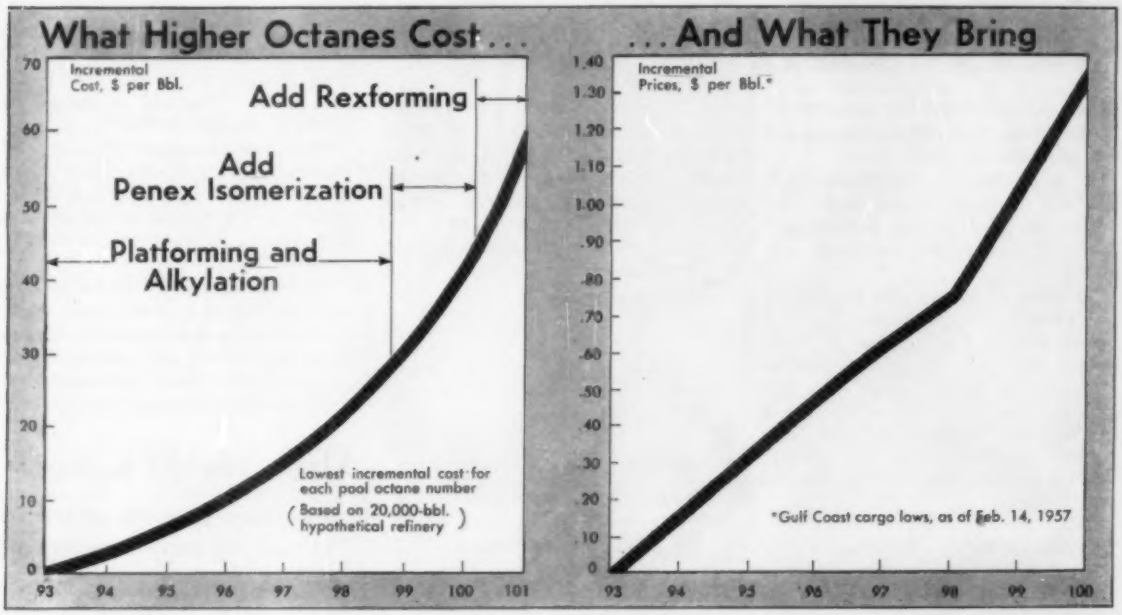
Select Cement to Fit the Job!



107 Octane in '65?

The all-gasoline weighted average then will be 101, up 8.8 numbers from 1956, U.O.P. scientist tells refiners

SAN ANTONIO.—Motorists in 1965 will be able to fuel their cars with 107-octane premium and 98-octane regular.

The weighted-average research octane rating of all U. S. gasoline then will be 101. And it will cost the average refiner more than 60 cents a barrel more than he's spending to make today's improved gasolines.

The refiner's most likely and desirable route to this record-quality motor fuel will be via alkylation and isomerization processing, backed up by catalytic reforming with extraction.

Major components of a 101-octane pool, based on a hypothetical refinery, will be: Reformate testing 102.8, leaded; alkylate at 103.5; isomerate at 95.5; cat cracked gasoline at 99.0; and butanes at 110.0.

The increase in pool octane numbers will match climb of 1.2 octane numbers per year noted in recent years and which brought the pool up to 92.2 (research) in 1956.

The refiner's economic picture, meanwhile, will be brightened by the market premium for high-octane fuels. Gulf Coast prices show 100-octane gasoline is worth $1.37 more per barrel than 93-octane.

What processing? . . . In making these observations to the annual Western Petroleum Refiners Association meeting here, S. W. Curry, Universal Oil Products Co., drew up a case based on a hypothetical 20,000-bbl. refinery.

He started out with a modern plant containing crude and vacuum distillation units, fluid catalytic cracking, gas-recovery facilities, a polymerization plant, and Unifining and Platforming units.

This plant has a basic gasoline pool octane number of 93. Its gasoline pool is composed of F.C.C. 425° end point gasoline (38.1 per cent); platformate (37.6 per cent); poly gasoline (6.3 per cent); straightrun (14.5 per cent); and butanes (3.5 per cent).

The 101-octane pool anticipated by Curry will find a drastic change in its components. Cat cracked gasoline and butanes will remain about the same (36.8 and 4.0 per cent, respectively). However, alkylate, isomerate, and rexformate (or its counterpart) will be prime blending components. They'll appear as 14.9, 10.3, and 34.0 per cent of the pool, respectively.

How to add numbers . . . The hypothetical refiner's first step in going from 93 to 94 octane will be via alkylation and mildly increased reforming severity.

Increased reforming alone would do the job, but at a higher cost than if alkylation facilities are added. With this latter unit's output available, the pool can be increased to 95 and 96 octane simply by adding TEL.

The cost to get to 96 octane from 93-octane hypothetical base will run about 9.7 cents per barrel. To get to 97-octane will be a big jump, running 15.3 cents per barrel above the 93-octane base. Increased reforming severities and addition of alkylate and lead will bring the pool to a 99 research octane number.

The next step, 99 to 100, is the breakthrough, where isomerization enters the picture. High-severity reforming at the 95 clear octane rating plus alkylate, isomerate, and other components will result in a 100-octane pool at a 45.5-cent per barrel cost over the 93-octane base.

To get to 101 pool octane would require putting in a new reformer with extraction facilities, or converting the existing one to such service. The cost would have increased to 60.2 cents per barrel to achieve this 101-octane stock.

Petrochem Outlook:

● Further growth in '57 after an 11 per cent gain in output last year. Petroleum-based chemicals now are a fourth of all chemicals in volume, half in value

SAN ANTONIO.—The petrochemical industry is still booming—and the end isn't in sight.

U. S. production of petrochemicals last year increased 11 per cent. Total output of 35.4 billion pounds was 24.9 per cent of all chemicals produced.

In terms of money, the production was even more significant. The 35.4 billion pounds had a value of $4.22 billion, 55.5 per cent of the value of all chemicals. These figures were presented before a technical session of the Western Petroleum Refiners Association meeting here by George Weber, refining editor of The Oil and Gas Journal.

The breakdown . . . Petrochemical intermediates now dominate the organic chemical field, Weber said. In the aliphatics group (straight-chain compounds), based largely on light paraffins and olefins, petrochemicals represent over 85 per cent of the total.

And last year, for the first time, the oil industry provided the bulk (58.9 per cent) of the basic aromatic chemicals. These aromatics are largely benzene, toluene, and xylene made in catalytic reforming operations.

In the inorganic field, petrochemicals account for 8.9 per cent of the total, a healthy slice when considering the many heavy-tonnage organics used by industrial concerns.

Ammonia from petroleum hydrogen, carbon black from natural gas, and sulfuric acid from hydrogen sulfide removed from petroleum and natural gas are the inorganics which are considered as petroleum-derived in arriving at this figure, he said.

From the standpoint of value, petrochemicals enjoy a much greater share of the total chemical field. Petrochemicals accounted for 82 per cent of the total value of aliphatics, 76 per cent of the total value of aromatics, and 16 per cent of the total value of inorganics.

Another method for measuring petrochemical output is based on the tonnage of basic petroleum and natural gas fractions which find their way into finished products other than fuels and lubricants. These feed materials to petrochemical processes totaled 24.65 billion pounds last year, Weber said.

Surprisingly, methane accounted for 14.40 billion pounds, well over half this total. Vast volumes of natural gas (predominantly methane) go into the manufacture of synthetic ammonia, carbon black, and methyl alcohol. These three products account for more than 75 per cent of end usage of this lightest hydrocarbon fraction.

Other fractions were used as follows:

Material—	Billions of pounds
Ethane	1.25
Propane	2.20
Butane	1.23
Pentane	0.25
Hexanes plus alkanes	1.22
Benzene	0.72
Toluene	1.04
Xylenes	0.70
C_9 plus aromatics	0.72
Hydrogen sulfide	0.95

This breakdown refers to basic hydrocarbon sources only. Thus, the relatively minor share of ethane and ethylene in the C_2 category does not represent the heavy volume of ethylene made as a secondary product from other basic hydrocarbons. Only that ethylene produced in refineries and used for petrochemical manufacture is counted in this breakdown.

In the aromatics field, the relatively recent rise in benzene, toluene, and xylene usage is shown in the present position of these three basics.

Hydrogen sulfide, recovered as such from natural and refinery gas, shows growing importance as elemental sulfur recovery plants are added in the field and in refineries.

What to look for . . . Of the workhorses in the petrochemical field, most show indications of continued expansion, Weber said.

Yearly consumption of ethylene should be 5.8 billion pounds by 1960, compared to 3.5 billion pounds last year. One of the fatest developments in the ethylene field is polyethylene. Nearly 400 million pounds of low-pressure polyethylene capacity is due to come on stream this year.

Acetylene will assume more and more importance in the petrochemical field, he said. This highly reactive building block has been in use for many years, but its source was primarily nonpetroleum. It is now said to be the No. 1 growth chemical in the Southwest, and most new capacity is based on light petroleum hydrocarbons.

Propylene is beginning to show considerable promise as a petrochemical basic. Last year, more than 1.5 billion pounds of this material went into petrochemical manufacture. About 70 per cent of it came from refinery gases. Demand will be increased by three products which use propylene as feed stock. These are polypropylene, synthetic phenol, and nitroparaffins.

Butadiene demand is increasing fast, and butane and butylene will be required as feed stocks in making this chemical. Yearly use of butadiene is expected to increase 15 per cent by 1960.

Benzene appears likely to continue in brisk demand, Weber said. About 114 million gallons came from petroleum last year, and indications are that refiners will have to provide about 300 million gallons annually by 1965.

Urea Helps Lubes

Two-step process practical in making easy-pouring oils

SAN ANTONIO.—A practical process has been developed for production of low-pour-point lube oils.

In a two-step operation, solvent dewaxing is followed by urea dewaxing of waxy crudes. In this process, urea forms a complex with the paraffinic wax. The complex is separated from the dewaxed oil, and then dissolved to yield wax and urea.

The entire operation takes place at ordinary temperatures, in contrast with temperatures below —50° F. that would be required by conventional dewaxing techniques.

Standard Oil Co. (Ind.) reported its experience with urea dewaxing to the annual meeting of Western Petroleum Refiners Association. The process is particularly well adapted for dewaxing light lubricating stocks most often used for low-cold-test oils.

It's not expected to compete with solvent dewaxing for lowering the pour test just to 0° F. It is well suited for further lowering the pour test of oils conventionally dewaxed. Hence, the two-step solvent-urea dewaxing operation is proposed.

In the process, urea selectively crystallizes around paraffinic hydrocarbons with long straight chains to make a solid, filterable complex. It will accommodate straight-chain hydrocarbons, but will not form complexes with cyclic or branched-chain molecules like benzene or isooctane. The oil is separated from the complex on a rotary filter of conventional design. The cake is then decomposed into a paraffinic byproduct and into urea, which is recycled.

Highway Plan: Squeeze or Advantage?

SAN ANTONIO.—The ultimate success of the huge federal highway program will depend largely on one thing—how much asphalt is used.

The program already is under way. And it looks like a $100-billion project for the next 13 years. Of this, federal aid for the 41,000-mile controlled access Interstate Highway System will amount to $27,839,000,000. This will be bolstered by state contributions of more than $33 billion.

Work on all roads and streets in the nation, including county and city expenditures, will probably boost the over-all bill for construction and maintenance to more than $100 billion.

This enormous program can have two effects on oil. It can bring a double headache, or it can provide a dual advantage to petroleum, and to the taxpayer.

Asphalt is the key. This point was driven home again and again in a special symposium at the forty-fifth annual meeting of the Western Petroleum Refiners Association here last week.

What has been a series of warnings in the oil business is now taking on the dimensions of a crusade. The issue is this:

By well-documented facts, asphalt manufacturers and users can prove that when properly applied, asphalt can provide, at lower cost and in faster time, a better pavement for any traffic requirement than can any other paving material.

What's involved . . . First, consider costs. The money is committed. How many miles it will buy depends on how much asphalt goes into the program.

The more miles of usable roads that result will add more demand for gasoline and lubes by the nation's motorists. Obviously, it means greater asphalt sales, too.

On the other side of the picture is the paying of the piper. If the road program turns into a spending spree without due regard for value received, the bill will be higher.

The bill will be paid out of tax dollars—and the oil industry is the collector. Unwarranted spending will raise the tax load on gasoline, and cut total consumption of petroleum products.

Reid Brazell, president of W.P. R.A. and of Leonard Refineries, Inc., opened the asphalt symposium by asking for more cooperation on the part of top management.

PHILLIPS' D. W. GAGLE
. . . 88 per cent is now asphalt, but . . .

He asked three things of oil company management.

. . . Evaluate the profit figure of asphalt versus residual fuel oil. You'll find it is a profitable item.

. . . Investigate the cost of equipment necessary to make quality asphalt.

. . . Evaluate the number of cars on the roads today using gasoline as a result of the use of asphalt.

Diminishing returns? . . . If the cost of highway building gets out of hand, the petroleum industry may feel the effect of lower product demand per car in this country, said Arvin S. Wellborn of the Asphalt Institute.

This is no idle estimate. It has already shown its effect in some instances. Following the gasoline tax rate increase last July, Nebraska's total gasoline tax receipts fell more than half a million dollars short of the same period in 1955.

Again, in the Northeast, three high-tax states—Maine, Connecticut, and Vermont—showed gallonage gains in 1956 of only 3 to 3.9 per cent over 1955. By contrast, New York, New Hampshire and Massachusetts, which did not raise taxes, showed gallonage up 5.1 to 7.1 per cent over the same period.

This future tax burden relates directly to the type of paving used in the program. Said Wellborn, "Savings in pavement cost amount to 20 to 50 per cent, and sometimes more, where asphalt is used instead of concrete. One prominent road expert estimated that $3 billion could be saved on the interstate system alone if it were paved with asphalt.

What to do? . . . This story can be put across only through the efforts of the oil industry itself. One way is through better support of the Asphalt Institute, said Brazell. This was echoed by W. B. Warden of Miller-Warden Associates, asphalt consultants of Swarthmore, Pa.

Warden went further in calling for better communications between manufacturers and users of asphalt. These two groups talk two languages. Neither understands the other's problems well enough to effect complete cooperation.

This can be corrected by giving asphalt sales personnel more experience and understanding in paving technology. Asphalt is still sold on a price basis with too little service and technical salesmanship. Company sales representatives need to sell asphalt vs. cement rather than selling their asphalt vs. some other company's asphalt, said Warden.

The success or failure of asphalt in many paving jobs depends not only on the quality of the product, but how properly it is blended with other materials. This is understood by too few oil-company representatives.

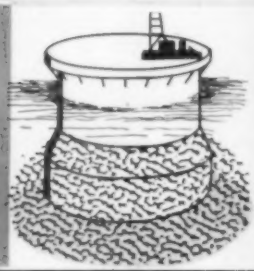
Asphalt is big business . . . D. W. Gagle, of Phillips Petroleum Co., reminded the industry that 88 per cent or 629,000 miles of highways in this country are paved with asphalt.

If this proportion is to be maintained several changes are needed, he said.

The first headache is too many grades. This is being improved. The Asphalt Institute has recently recommended reduction of asphalt cement grades from nine to five. Later this may be further reduced to three. This trend does not mean sacrifice in quality, but better service to the customer and better construction results through greater uniformity.

Another headache is specifications. Some are good and some are bad. One bad spec is the spot test, Gagle said. Cracked asphalt gives a positive result in this test. But the test also shows positive on some excellent asphalts which contain no cracked materials. Hence it is used arbitrarily, it penalizes some good asphalts.

Mobile Platforms Designed to Meet Every Job

Depth Range	Type	Approx. Cost	
250 Feet of Water		120 FT.: $462,000 150 FT.: $515,000 200 FT.: $650,000	• Two-deck platform supported by six, 4-ft. tubular legs at least 130 ft. long. • Anchored to ocean floor by drilling and cementing. • It'll handle 30-60 wells.
100 Feet of Water		$325,000	• Two triangular decks resting on three shorter steel legs anchored like six-legged unit. • It requires drilling tender, but will handle 21 wells to the 10,000-ft. depth.
60 Feet of Water		$630,000	• Two cylinders, one inside other, form portable island. • Two decks plus cellar will accommodate 21 wells

Designers Unveil New Offshore Fleet

LOS ANGELES. — When the big drilling push begins in California, operators will have a variety of mobile platforms to choose from.

The equipment already is designed to suit the peculiar wave forces and ocean-floor conditions of the California coast. It awaits only the asking to be built.

A new Los Angeles concern, McCarthy & Smith, has prepared detailed plans for three types of structures. Simple construction used in two of the platforms will permit either to be launched within 90 days after firm offers are received.

The three types for which designs are complete are:

. . . For 60-ft. waters, a 90-ft. steel cylinder topped by a circular platform for use as a portable island.

. . . For water up to 100 ft. deep, a tripod with a two-deck, triangular platform.

. . . For water up to 250 ft. deep, a six-legged structure with a 68-ft. circular deck.

All three can be fabricated on shore and floated to drill site. There they can be filled with water until the legs —or base in case of the island—rest on the ocean floor.

The methods of leveling and anchoring the platforms vary. But all are designed to withstand 125 m.p.h. winds. All are salvageable after they have been used for drilling and later for production platforms.

George McCarthy, senior member of the new firm and also president of Shamrock Drilling Co., said the platforms are designed for the hard ocean floor existing offshore from California. But they also can be adapted for soft, silty conditions by making certain modifications.

What's the cost . . . All three platforms comply with the 20-well minimum for each drill site specified recently for submerged leases by the State Lands Commission.

The portable island and tripod types allow drilling of 21 wells from the same location. From 30 to 60 wells may be drilled from the six-legged structure.

Assembled costs of the platforms range from $325,000 for the tripod to about $630,000 for the island. This

includes cathodic protection and other anticorrosion measures. It does not allow for crew quarters or drilling equipment.

Cost of the six-legged tower varies with the depth range (see chart).

These prices, which McCarthy says are based on estimates from large West Coast steel fabricators, are well below those spent on Gulf Coast platforms. This is particularly true from the cost-per-well viewpoint. Since a greater number of wells can be drilled at each site, the single well cost drops.

McCarthy made clear his firm is ready to provide platforms. They will be rented by a sister company, Marine Exploration Co., he declared. "A manufacturer who gave us cost estimates will agree to fabricate, assemble, and launch a tower for either 100 or 150-ft. waters in 90 days after a firm order."

Problems different . . . California operators face problems different from those met by Gulf Coast companies.

Waters within the 3-mile limit get deeper much faster. Wind forces are not as much a problem but wave forces involved are higher.

Ocean-floor conditions also are different. Not only is the West Coast more uneven, but in many areas it has been scoured to a hard shale or rock bottom. This makes it difficult to drive interlocking steel pilings for land-filled or caisson-supported structures.

Because operators will be working closer to shore, the California companies will not have to provide the large crew quarters found on Gulf Coast platforms. In most developments, crews probably will work 8-hour tours the same as on land-based rigs.

So that crew boats can make as short a run as possible and not have to depend upon piers of nearby beach communities, McCarthy & Smith have plans for a temporary landing pier. All fabrication will be done on shore.

The tripod . . . Designer of the three platforms is Verne Smith, formerly chief engineer for Electric Boat Co. and a West Coast shipyard. He said the tripod platform probably will be the first built.

It has legs 4 ft. in diameter and 129 ft. long. Each leg has a 24-in. inner cell where four vertical buoyancy tanks are installed. The platform itself has two triangular decks, the lower one 29 ft. above mean water level. Each deck provides 1,800 sq. ft. of working area.

Drilling equipment is mounted on a platform which revolves around a center pivot on the main deck. This equipment includes the mast, rotary table, draw works and a standby generator. Most other equipment is installed on a drilling tender.

Platform is towed to location in horizontal position
Sea Level
Removable Rubber Buoyant Units
Water chambers in legs are flooded to bring platform into upright position...
Spud
Drill-in bit

The structure will be fabricated in sections and assembled on building ways. After being launched, the platform will be towed to the offshore site in a horizontal position. Each leg is buoyant within itself but 16-ft. diameter ballons will be attached to the column just below the deck to gain added buoyancy (see sketch).

On location the platform will be turned into a vertical position by pumping water into the bottoms of the columns. When the legs rest firmly on bottom, they then can be dug in by an unusual method until the low horizontal buoyancy tanks rest on the ocean floor. This digging-in is accomplished like this: Small rotary tables are mounted on the platform. Tubing inside the 24-in. pipe will rotate a bit contained in the bottom of each leg. It drills a hole in which the leg is anchored.

After the legs are dug in, the rotary and tubing are removed. Piles 90 ft. long and 14 in. in diameter will be driven and then cemented. Time required to complete the entire operation is estimated at from 5 to 10 days. The time actually depends on the length of tow, depth of water, and ocean-floor conditions.

When fastened to the bottom, the tripod platform will withstand 125-mile winds and 35-ft. cresting waves. Each leg is designed to carry 1,240,000 lb. dead load with a safety factor of 3. It will handle equipment to produce 21 wells and complete drilling equipment to drill 10,000-ft. wells with 4½-in. drill pipe.

The six legger . . . This platform is similar to the tripod. Only it has three more legs and can operate in deeper waters.

The legs are 4-ft. columns. For work in 100-ft. water, they are 130 ft. long, placing bottom of the lower deck 30 ft. above water. All drilling equipment can be mounted on the 68-ft. diameter rotating machinery deck. All pumps and producing equipment will go on the lower deck. The platform can be used with or without a drilling tender.

The same procedure is used for launching this platform, towing it to location, and putting it in an upright position. There's one difference, however. Jacks and spuds are needed to level the structure before the piles are driven.

Plans also have been made to use this platform for 250-ft. water.

Portable island . . . The secret of this structure is two cylindrical shells one inside the other.

The outer shell is 85 ft. in diameter, the inner one 69 ft. The annulus is divided into 16 water-tight buoyancy tanks. Base of the hull flares out to 104 ft.

Diameter of the working deck is 116 ft. Drilling equipment is mounted on a revolving platform as on the other structure. Pumps and other equipment are placed on the machinery deck 14 ft. below the top deck. Wellheads are in a cellar, separated into compartments for safety purposes, 6 ft. below the machinery deck. If the completed wells require pumping units, these can be mounted on the machinery deck.

The structure will be assembled on building ways where all drilling equipment may be put aboard. Then it will be launched in the same manner as a boat. Its esimated draft is 17 ft. loaded with all machinery, drill pipe, and miscellaneous equipment.

After the platform is towed to location, the buoyancy tanks are filled with water until the unit rests on bottom. Eight punch piles are driven as a safety measure against horizontal movement. Rip-rap then is placed over the skirt portion of the shell further to stabilize the platform.

If lease requirements demand an earth-filled island, a suction dredge can be used to fill the inside of the cylinder with sand. Engineers of the California State Lands Commission have advised McCarthy & Smith that this will be considered a "land-filled island."

One of the two fabricating companies which furnished estimates on cost of the platform suggested it be built of aluminum alloy. This alloy has been developed for salt water use. The cost would be higher — about $815,000 compared with $630,000 for steel—but lower maintenance costs and the lighter weight would offset the cost.

First Strikes Hit Oil

Concerted effort cuts sharply into product supplies in Detroit; big Aurora and Socony refineries affected

DETROIT.—The spring breach in labor-management relations widened here last week after Michigan's two biggest refineries cut back runs as a result of strikes.

But management was continuing to hold the line against the Oil, Chemical and Atomic Workers International Union's demand for a 27-cent hourly wage increase.

Labor's rebuttal to this line-holding tactic was more get-tough talk, some name-calling, and threats of "economic force."

Here was the picture around Detroit:

...A refinery strike involving 350 O.C.A.W. members of the 42,000-bbl. Aurora Gasoline Co. plant here was called "absolutely illegal, and a desperate effort to dry up the Detroit market."

Aurora says the strike violates the Taft-Hartley law, which requires a 30-day notice to the Federal Mediation Conciliation Service. Strike notice was given March 21, and the workers walked off the job March 24, Aurora officials said.

The company has filed an unfair labor-practice charge with the National Labor Relations Board. Meanwhile the refinery is gradually closing down its units.

...A marketing strike involving 700 employes of seven major oil distributors in Detroit is the reason behind the Aurora strike.

The truck-driver and bulk-plant strike started at Socony Mobil Oil Co., Inc.'s, distributing plant in February and has snowballed to affect Shell Oil Co., Gulf Oil Corp., The Texas Co., Standard Oil Co. (Ind.), Sinclair Oil Corp., and Pure Oil Co.

...Socony Mobil cut back runs "drastically" at its 30,000-bbl. Trenton refinery just south of Detroit. The company has given workers 2-week notice of a possible shutdown.

The refinery is not strike bound. But it had to cut runs when products started to pile up because of the marketing strike.

Indiana deadline . . . In Chicago, Indiana Standard is pushing a counter-proposal on another labor front. The firm has set an April 1 deadline for Central States Petroleum Union to accept a 4 per cent wage increase.

But C.S.P.U. has been holding out for a bigger increase. The 12,000-member union had originally asked for a 10 per cent hike (25 cents hourly), but recently it hinted it would accept 6 per cent.

Indiana Standard's 4 per cent offer is the same as that accepted by the 6,500-member Independent Petroleum Workers of America at the company's Whiting, Ind., refinery earlier in March *(The Oil and Gas Journal, March 18, page 85)*. This was the first important agreement of the year —and was far short of demands.

West Coast . . . In Wilmington, Calif., the O.C.A.W. local has recommended that a strike vote be taken at four refineries in that area.

After several months of negotiations the union has not yet received counter-wage proposals from any of the four companies involved — Richfield Oil Corp., Shell Oil Co., The Texas Co., and Union Oil Co.

Other big companies have been holding out in other parts of the country. Sinclair Oil Corp., which has the largest nation-wide O.C.A.W. contract, hasn't offered counter proposals for the union to consider. Sinclair and the union have not met since early in March *(The Oil and Gas Journal, March 11, page 101)*.

In Canada . . . Labor has had better success in Canada. The O.C.A.W. local at Sarnia was given a 20 per cent increase and new fringe benefits in a 16-month contract for 1,600 workers at Polymer Corp.'s synthetic-rubber plant.

This includes an 18 to 27-cent hourly increase as of February 27, 1957; a 6 to 10-cent raise next August 27, and another 5 to 8-cent hike February 27, 1958.

At unorganized refineries at Sarnia and Montreal, Imperial Oil, Ltd., offered workers a 9 per cent increase —3½ per cent below the employes' goal.

Smog Could Force Fuel Changes

LOS ANGELES.—Refiners in the Los Angeles area now are fighting a new smog threat: A proposed change in motor-fuel blends to help control automobile exhaust fumes.

The threat arose last week at a West Coast section meeting of the Air Pollution Control Association. It precipitated a sharp debate. One group claimed changing motor-fuel components would reduce smog formers in exhaust fumes. Refinery researchers, however, cited tests showing that composition of auto exhausts is independent of the fuel used.

Automobile exhausts received a going over as a big smog culprit because of these facts:

Half of the 1,100 tons of hydrocarbons released daily into the Los Angeles atmosphere come from autos. The exhausts also are the source of 98 per cent of the dangerous oxides of nitrogen.

Other approaches to the exhaust problem besides new fuel blends were discussed. The possibilities:

...Afterburners for cars, either of direct flame or catalytic type.

...Fuel cutoff devices to regulate flow of fuel into engine while car is slowing down, the critical period in smog forming.

L. M. Richards of Western Oil and Gas Association said fuel composition has no effect on composition of the exhaust.

He said studies by Stanford Research Institute and General Motors indicated that after fuel is fed into the cylinder of an engine any unburned material is so changed by heat and pressure that all exhaust is alike.

L. A. Chambers, director of research for the Air Pollution Control District, declared studies by his group showed olefinic compounds of motor fuel appeared to be the worst smog formers. He said some reductions are possible in highly reactive hydrocarbons by using gasolines of differing compositions.

One factor brought up is the tendency of tetraethyl lead in motor fuels to complicate use of a catalytic afterburner. While leaded gasoline appears not to increase smog, it poisons the catalyst in the afterburner and nearly eliminates use of that smog-control device.

Although the afterburners reduce offending exhausts, researchers said they are not too optimistic about their future. The initial cost to the motorist would be substantial, and users would be faced with periodic inspections and servicing.

Railway Upheld

● Northern Pacific wins court battle to prevent forced sale of grants

GREAT FALLS, Mont.—Northern Pacific Railway Co.'s ownership of thousands of acres of granted land in Montana has been upheld by U. S. District Court Judge Charles N. Pray.

Much of the land is in the Williston basin and other oil-producing areas.

The judge quashed a motion by Keith C. Morton of Conrad, Mont., to compel the railroad to sell him a quarter-section of land in McCone County at $2.50 per acre.

The suit was one of four filed in state District Court at Helena in November 1955, by Morton and three other war veterans — Gene A. Picotte, Robert E. Kuntz, and John W. Mahan. Each of the three also sought a quarter-section of granted land. The section had been leased to Shell Oil Co. for oil exploration.

Morton's case was transferred to federal court here December 8, 1955. Although the judge's ruling was made specifically against Morton, the decision has the effect of repelling the three other suits as well.

Here's what happened . . . Morton claimed he was entitled to buy the quarter-section for $400 under an 1864 congressional act, an 1870 congressional joint resolution, and under terms and provisions of the land laws and homestead acts of the United States.

The 1870 resolution granted the railroad alternate strips 10 miles wide along the right-of-way to encourage westward development of the line.

Morton's chief contention was that the resolution stated lands "hereby granted" to Northern Pacific "at the expiration of 5 years after the completion of the entire road, shall be subject to settlement and preemption like other lands, at a price to be paid to said company, not exceeding $2.50 per acre."

Northern Pacific attorneys argued that congressional acts and resolutions do not force the railroad to sell the land.

Judge Pray's decision stated, in part:

"It seems to have been clearly established that the joint resolution granted no indemnity lands in Montana; that it made a new grant between Portland and Puget Sound; that the term 'hereby granted' in the settlement and preemption provision applied only to the place land in the new grant."

watching WASHINGTON

. . . with Bertram F. Linz

House report may help oil . . .

THE House commerce committee is expected to get the jump on other congressional groups probing the European oil lift by filing its final report first.

Sen. O'Mahoney's judiciary-interior subcommittee got started first on the study of the industry's effort to rescue Europe from an oil famine. But Rep. Harris' group, in a few sessions, got the facts by sticking to the main subjects—the oil lift and price increases.

Hearings on both sides of the Capitol wound up March 22. O'Mahoney's staff will have a job separating the wheat from the chaff among the many angles explored by subcommittee members. The House committee has only a small record to review.

The House report, if it comes out first, will take a lot of fire out of O'Mahoney's analysis of how the industry acted after the closing of the Suez Canal. By and large, it is expected to be more friendly to the Middle East Emergency Committee. And it is expected to take a realistic view of price increases.

O'Mahoney's report probably will cover a lot of ground. His subcommittee bore down heavily on price increases. It went into a variety of matters that had only slim connection with the oil lift, such as Aramco's taxes. But it is expected to say that, after all, the oil companies did a good job to keep Europe warm and at work last winter.

Hot topics: Depletion, taxes . . .

THE depletion allowance and the taxes paid by oil companies operating abroad have become live subjects in Congress.

There is not too much chance of action on either this year. But a general tax bill will be brought up next session. This will aim at giving voters a pre-election tax cut. Efforts will be made to offset some of the revenue loss by trimming the so-called "privileges" given the oil industry and other groups.

Sen. John Williams of Delaware has long been urging that the depletion allowance on oil and gas be cut to 15 per cent. Last week he sought to have the cut attached to the bill extending the 52 per cent corporate rate for another year. Time was against him, however. The bill had to be signed by the President before April 1 to keep the present rate in force.

On the House side, Rep. Charles A. Vanik of Ohio has been pounding away at the taxes paid by the international companies. They are allowed to offset taxes paid foreign governments against their U. S. taxes. The result, Vanik says, is that they pay little or no tax here.

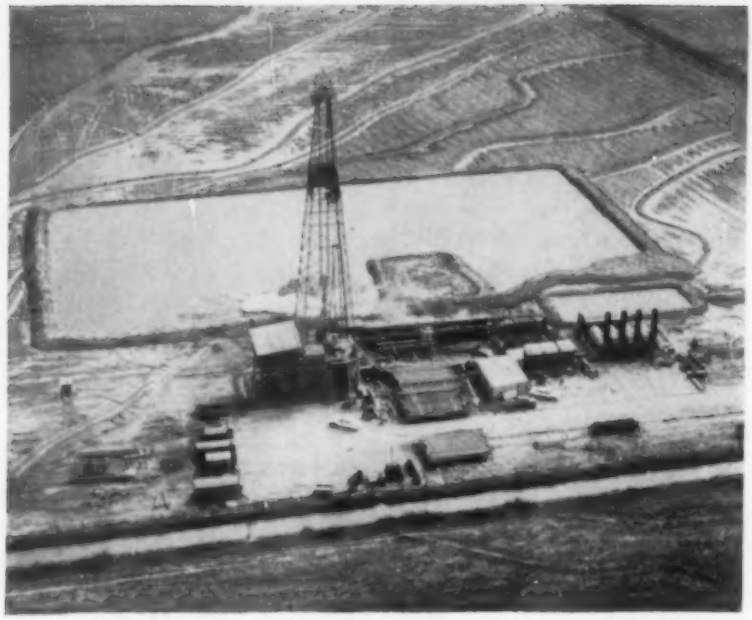
Tankers jam shipyards . . .

TANKER interests appear to have taken over the U. S. shipyards in a big way.

Shipyards are jammed with tanker contracts. Construction orders totaling more than a billion dollars in oil carriers were on the books as of March 1, the Maritime Administration reported.

There were 106 tankers under contract at the start of last month. Only 13 vessels of other types were on order. The 101 tankers to be built or converted for private account will cost $1,083.4 million. Five vessels for the Government will cost $29.8 million. Against this total of $1,113.2 million for oil carriers, other vessels to be built will come to only $164.7 million.

The big bulge in tanker building started only a few months ago. So the ships now are coming off the ways only in small numbers. Only three were delivered during the fiscal year ended last June 30. So far this fiscal year six have been turned over to their owners.



Tidewater may have 100 ft. of pay now that . . .

High Pressure Sands Tamed

CROWLEY, La.—Tidewater Oil Co. and associates have run the first drill-stem test in a high-pressure gas sand which until recently was considered too dangerous to test.

Bottom-hole pressure of 12,395 psi. was recorded in the deep test, the 1 H. Thibodeaux. The well is in the Church Point field of Acadia Parish, Louisiana.

Although pressure in the sand was high enough to scare operators away just 2½ years ago, several wells—including the world's deepest test—have since been completed with higher pressures.

Tidewater first drilled into the sand late in 1954. The company's 1 Daigle, about 1,500 ft. west of the 1 H. Thibodeaux, was plugged back and later abandoned. Decision to complete the earlier well in a shallower formation was prompted by a threatened blowout through 17.7-lb. drilling mud. Bottom-hole pressure at that time was estimated at about 13,000 psi.

It was largely because of new improvements in drilling equipment plus recent experience in drilling and completing deep wells that Tidewater decided last fall to take another look at the promising sand *(The Oil and Gas Journal, October 29, 1956, page 68).*

Participants in the new venture budgeted $756,000 for the well. Besides Tidewater, they include Gulf Oil Corp., Amerada Petroleum Corp., and Petroleum Reserves, Inc.

Results of test . . . It appeared last week that the gamble might pay off. After drilling through the long-neglected sand, the operators ran a drill-stem test of a 2-ft. interval at 14,314-16 ft.

With a full water cushion above the perforations, shut-in pressure at the surface rose to 5,950 lb. in 4 minutes. The pressure stabilized at that point during the 36-minute test.

Although the well was not permitted to flow, it is expected to produce at the rate of 12,000,000 to 15,000,000 cu. ft. per day.

The well is on a 1,020-acre lease held by the four participants plus Atlantic Refining Co. Tidewater also has an interest in more than 1,000 acres northeast and southwest of the potential producer.

The well topped the high-pressure zone, probably to be known as the Thibodeaux sand, at 14,296 ft. This is more than 350 ft. below the top of the same sand in the first test.

Operators estimated that there was a net pay sand about 100 ft. thick between 14,296 and 14,462 ft. in the Thibodeaux test.

Tidewater drilled to 14,800 ft., but it took three tries to do it. The hole was sidetracked after an unsuccessful fishing job at about 14,350 ft. where drill pipe was stuck. After reaching a depth of about 14,500 ft., the hole was lost again.

While drilling into the high-pressure sand, Tidewater used a drilling mud varying in weight between 17.9 and 18.2 lb. per gal.

The crew was preparing last week to run 4½-in. pipe before perforating a larger interval. Plans call for producing the well through 1½-in. tubing inside the 4½-in.

Pipelines Extended

Great Lakes to add new area to products system

KANSAS CITY.—The Great Lakes Pipe Line Co. products system will be extended this year into two new markets—Eau Claire and Superior, Wis.

These extensions, plus increased capacity into Chicago, highlight an expansion program to be financed by sale of $15 million in 25-year debenture bonds. Part of the plans were disclosed late last year *(The Oil and Gas Journal, December 24, 1956, page 51).*

The newly announced projects are:

. . . A 140-mile 8-in. line from the Great Lakes Minneapolis terminal to Superior, where shippers will build their own terminals.

. . . A 34-mile 12-in. line from Tulsa to Barnsdall, Okla., to supplement existing 8 and 12-in. lines.

. . . A 14-mile 8-in. line to replace the 4-in. line from Coffeyville to Independence, Kans., and an 11-mile 8-in. line from 10 miles east of Donahue, Iowa, station to six Mississippi River terminals at Bettendorf, Iowa.

. . . New pumping units at Albert Lea, Minn., and a new station at Mason City, Iowa, to increase capacity at the Mankato, Minn., terminal.

Modernization of the Chicago terminal also is planned. Projects announced in December were the 84-mile 8-in. extension from Newport, Minn., to Eau Claire, where shipper terminals will be located; a 68-mile 12-in. line from Middlebury Junction, Ill., to Chicago, paralleling a 6-in. line laid in 1931; and a 15-mile 6-in. line from Lincoln, Neb., to the Lincoln Air Force base.

The 5,000-mile system pumps products northward from Tulsa.

New Recovery Ideas Tested

BAKERSFIELD, Calif.—Two important secondary-recovery pilot projects are being set up in this area.

Ohio Oil Co. is attracting interest with a miscible phase displacement experiment it plans in a small Stevens sand pool in South Coles Levee field 20 miles southwest of here. Ohio will

inject ethane and propane produced at the field and follow with dry gas. It's the first time the new recovery technique has been used in California.

Richfield Oil Corp. is preparing to start the state's third fire-flood experimental project in the coastal region. It will conduct the thermal-recovery test in the Oaji field, Ventura County.

Secrets Periled

California wants to see tidelands seismic data

SACRAMENTO.—The oil industry last week lost the first round of a fight to keep secret its seismic records on offshore California leases.

Over protests of the industry, the state assembly passed a bill which compels oil companies to give seismic and core-hole data from state-owned tidelands to the State Lands Commission.

The vote was a victory for Assemblyman Allen Miller who is trying to revise the Cunningham-Shell Tidelands Act setting up rules for offshore operations. Miller declared the state needs the seismic information to evaluate bonus bids of companies seeking offshore parcels.

"The state owns these lands, not the oil companies," Miller said. "Certainly the owner of property should know what he has."

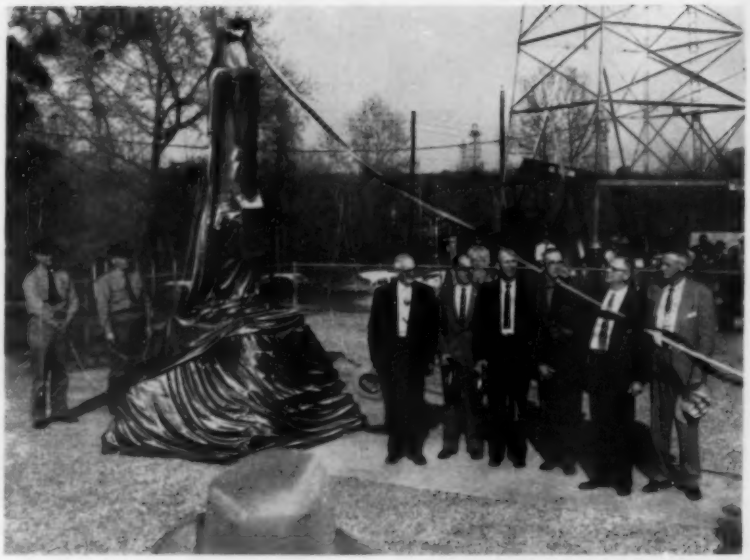
Under present rules, oil companies can conduct coring operations to 500 ft. below the ocean floor without a permit. But for core work deeper than 500 ft. a permit is required, and the companies are forced to make any information obtained below that depth available to the state.

Miller's bill changes this setup by requiring companies also to make available the information above 500 ft.

Wants more royalty . . . Miller also has introduced a bill changing royalty provisions for the state-owned tidelands.

He proposed a 12½ per cent sliding scale royalty on all the 135 miles of tidelands opened up in 1955 by the Cunningham - Shell Act. The royalty now is a flat 12½ per cent on wildcat lands and a sliding scale to 16⅔ per cent on development acreage *(The Oil and Gas Journal, March 11, page 110).*

This royalty provision now requires the State Lands Commission to classify the leases as either wildcat or development. Miller claims, as a result, the state is at a big disadvantage by not having the exploration data to evaluate the parcels.



DAD JOINER'S drilling crew unveils the symbolic oil monument as . . .

Industry Salutes East Texas

LONGVIEW, Tex. — Oil pioneers who discovered and developed the huge East Texas oil field were honored in day-long ceremonies here late last month.

The celebration started with a luncheon in Longview and ended with a big crowd watching the dedication of a monument near C. M. (Dad) Joiner's East Texas discovery well—the Daisy Bradford 3, in Rusk County.

A bust of the symbolic "Joe Roughneck" was dedicated by E. C. (Ed) Laster (see photo), driller for Dad Joiner's discovery, and other members of the crew. The site, called Pioneer Park, is near Henderson on the Tyler highway. The monument has a stone base anchoring a short joint of oil-field casing which is capped with a bust of "Joe Roughneck."

The celebration was sponsored jointly by Lone Star Steel Co. and the East Texas Chamber of Commerce.

The casing actually is a time capsule. It was sealed last year at Dallas on East Texas Day during the Texas State Fair and will be opened in 2056.

It contains letters from President Eisenhower and high-ranking state officials, maps, movies, copies of current magazines and newspapers, the Texas Almanac, a Bible, and 100 shares of Lone Star Steel stock. The stock and earnings will go into a college scholarship fund for East Texans in the next century.

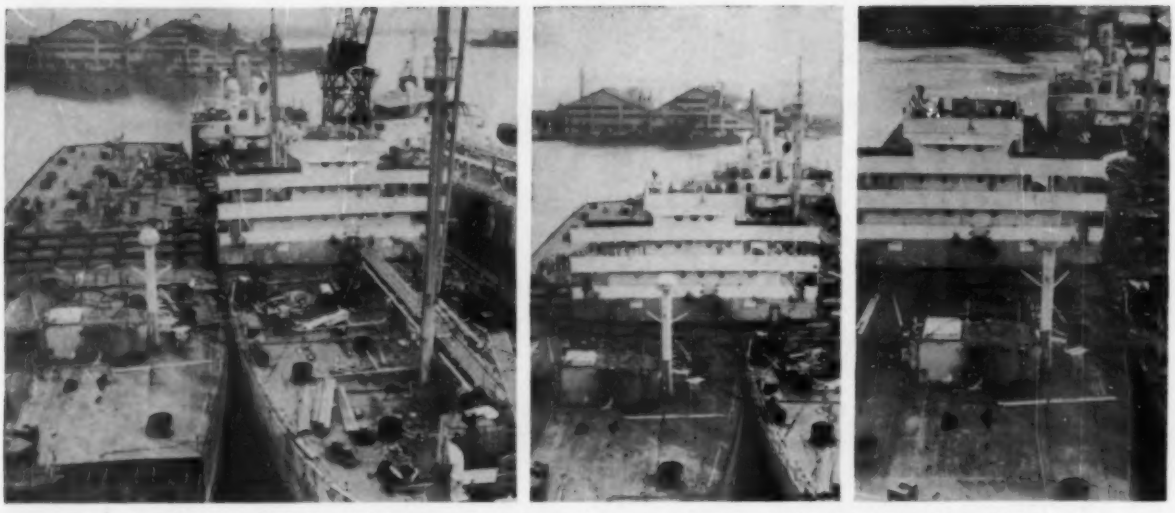
Public good faith needed . . . An imposing array of speakers headed by Jake L. Hamon, chairman of the board of the American Petroleum Institute, saluted the field's pioneers.

The list included Olin Culberson, chairman, and William J. Murray, Jr., member, Texas Railroad Commission; James W. Aston, president of Dallas' Republic National Bank; Dr. Willis Tate, president of Southern Methodist University; E. B. Germany, president of Lone Star Steel; Carl Estes, publisher of the Longview News-Journal; and W. A. Pounds, president, and Fred Pool, general manager, East Texas Chamber of Commerce.

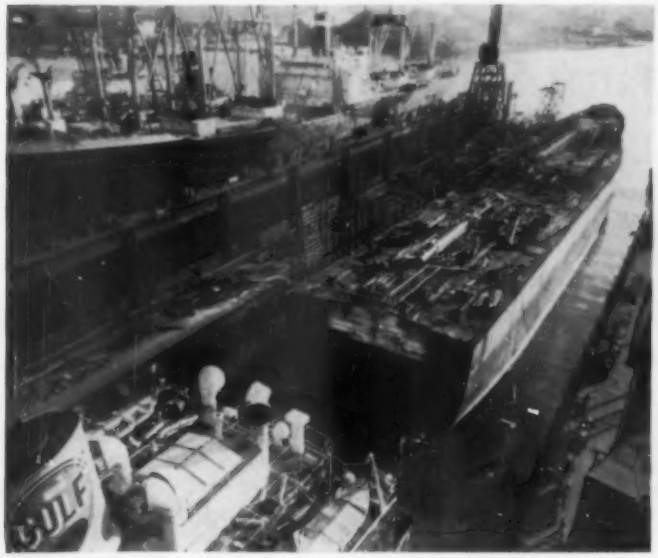
Hamon spoke at the luncheon. He said oil's biggest single problem is "public relations"—not the need for more reserves, capital, technology, or equipment. All its other problems will take care of themselves if oil can work in an "atmosphere of sympathetic understanding by the general public.

"The vast majority of the American public thinks of the oil industry in terms of the gasoline pump at the corner service station. When you get out of the relatively few states in which there is substantial production, the public looks upon the oil business as a magic hole in the ground which enables Texans to become millionaires at the expense of every man who drives a car and buys gasoline.

"Oil, to the great unschooled masses, comes in a can. You put it in your motor, or it comes in a bottle and you put it on your hair. An oil well is something that spouts Cadillacs."



SLIDE: Gulf Oil Corp.'s war-built T-2, "Gulfmeadows," shows how to put on weight, about 3,300 lb., by jumboizing. In the first step, deck house is shifted from tanker to new midsection, which will be welded between bow and old midsection.



SLICE: Tanker is then sliced apart to make room for new midsection, which adds 30,000 bbl. of capacity.

SPLICE: In final step, new midsection is floated in for welding in place. It's . . .

The Shortest Way to Longer Tankers

FACED with well-filled shipyards the world over busy building supertankers, American tanker operators are beating the odds by splicing aging tankers and coming up with bigger ships for a fraction of the cost of new ones.

The process is known as "jumboizing." It is being applied almost exclusively to war-built T-2 tankers, for years the backbone of the oil-carrying fleet. The possibilities involved are tremendous when you stop to think that about 500 of these old-faithful vessels are approaching the normal end of their useful lives.

The whole thing is really very simple. It involves slicing away the bow and stern of a 16,000 to 17,000-ton T-2, and welding a new and larger oil-carrying midsection between the two. Presto! A new and larger tanker with another 15 years of active service with more capacity than the original vessel.

The process costs about half what a new ship would cost in a shipyard. It can all be done in a fraction of the time involved in building a new ship. And, probably as important as any other factor, that new midsection can be built in the shipyard while the tanker is being used every day—at about $6,000 a day to the operator.

A T-2 spends about 2 months in a shipyard being "jumboized." A new tanker the same size couldn't possibly be delivered before 1960. The new vessel would cost twice as much—at least—as the enlarged older ship.

Here's how it works:

. . . An aged and somewhat weary T-2 moves into drydock, stern first.

. . . The stern is cut away from the midsection and bow.

. . . The bow is sliced from the midsection, which is then scrapped.

. . . A new and larger midsection is welded to the stern and then to the old bow and the new ship is ready for service.

The new section . . . The new midsection weighs about 3,300 tons. It is 354 ft. long and adds 48 ft., 6-in. to the over-all length of the T-2, and about 7 ft. to its beam. Most important, it increases the deadweight tonnage of the vessel to 20,000 tons and increases its carrying capacity by 30,000 bbl.

The new midsection is fabricated in the shipyard while the tanker is being used. No time is wasted in the process. When the new midsection is ready for splicing, the old tanker moves into the yard and the addition is made with a minimum time loss.

In most cases, the old and new midsections are ballasted and tied together and the midbridge is shifted from the old section to the new. (See photos.)

Who's doing it . . . The first tanker to undergo the renovation is the S.S. Amoco Delaware. It should leave a Newport News, Va., shipyard early in April.

Right behind the first will be the Gulfmeadows, a Gulf Oil Corp. tanker. The Gulfmeadows (pictures) is the first of nine such ships which Gulf plans to give the treatment.

American Oil Co. plans to jumboize three more T-2's after the Amoco Delaware is completed. All will be enlarged at the Newport News Shipbuilding & Drydock Co. Six Gulf tankers will undergo the same treatment at Maryland Shipbuilding & Drydock Co. in Baltimore and three more will come out of Bethlehem Steel Co.'s yards in Boston.

The same Boston yard will jumboize two T-2's for Socony Mobil Oil Co.; Maryland Shipbuilding will enlarge two for American Trading & Production Corp., Baltimore; and Alabama Shipbuilding & Drydock Co., Mobile, will handle two for Charles Kurz & Co., Inc., Philadelphia.

Results . . . The principal advantage gained by this process is in carrying capacity. Since there are no changes in engines or other vessel equipment, little is changed from the old standard T-2. Gulf, for example, expects to find very little change in the ship's operating speed and other characteristics once the change is made.

Gulf plans to use all nine of its jumboized T-2's to move crude and products from the Gulf of Mexico to the company's Philadelphia and Staten Island refineries or East Coast ports that serve the company's marketing areas.

"Jumboizing" Goes West

LOS ANGELES. — Richfield Oil Corp. has awarded a contract for "jumboizing" its tankship "David E. Day" to Todd Shipyards Corp. The work will be done at Todd's San Pedro yards.

This job, the first of its kind on the West Coast, involves increasing the 12-year-old T-2 tanker's length 49 ft. and its beam 7 ft. Capacity will be boosted from 134,000 bbl. to 175,000 bbl.

A new cargo tank section will be fabricated in Todd's yard while the tanker is still in service. When the section is ready, the tanker will be taken out of service, cut in half, and the new section welded into place. The $3,500,000 conversion job is slated for completion by July 1958.

Salt Lake Expands

Capacity to be raised on crude and products lines

SALT LAKE CITY.—Salt Lake Pipe Line Co., subsidiary of Standard Oil Co. of California, will expand its crude and products systems this year to keep pace with the growing markets of the Rockies and Pacific Northwest.

Capacity of the 10-in. crude line from Rangely, Colo., to the Salt Lake City refining area will be increased 14,000 bbl. to 70,000 bbl. per day. Salt Lake will lay 100 miles of 10-in. loop and add pumping facilities at existing stations.

The Salt Lake City-Spokane, Wash., products line will be expanded by 10,000 bbl. per day on the section to Boise, Ida., by installing new pumping facilities. From Boise to Pasco, Wash., 80 miles of 8-in. loop will be laid to increase capacity 5,000 bbl. per day. These expansions will raise capacity to 56,000 bbl. per day from Salt Lake City and 30,000 bbl. per day from Boise.

Both the crude and products projects are to be completed by the end of this year.

The 700-mile 6 and 8-in. products system has already been looped along more than half its length. The expansion may influence the decision on a new parallel products line which has been studied by Standard Oil Co. (Ind.), Phillips Petroleum Co., Sinclair Oil Corp., and Continental Oil Co.

——— *Industry* briefs

Douglas Oil Co. of California is purchasing two-thirds of the common stock of Apex Petroleum Corp. of Long Beach and plans to buy up the remaining shares later. Douglas is paying $14.85 a share for about 66,665 of the 200,000 outstanding shares of Apex.

The deal will give Douglas 3,000,000 bbl. of additional reserves, just about double what the company now has. This includes interest in 83 producing wells, mostly in West Wilmington and Signal Hill fields, from which Apex gets 1,000 bbl. daily. Douglas said the new production is "ideally suited" to the asphalt operations at the Douglas Paramount refinery.

A bill to levy a 2 per cent severance tax on oil and natural-gas production in Kansas has survived a motion to kill. In a roll-call vote on the motion, the senate favored it 20 to 18.

Opponents of the measure argue that half of Kansas' productior is by independent operators who, they say, can't stand the additional taxes. There is no current severance tax on minerals in Kansas. If the new bill goes through, it will mean an estimated $8 million in revenue.

The National Petroleum Council has appointed a committee to report on inventory levels and aboveground storage capacity for crude, natural-gas liquids, and principal products. The committee was appointed at the request of the Interior Department's Oil and Gas Division. R. L. Milligan, president of Pure Oil Co., heads the committee.

Utah is scheduled to become the twenty-seventh member of the Interstate Oil Compact Commission. Legislation permitting the move has been signed by Gov. George D. Clyde. The state passed its first comprehensive oil and gas conservation bill in 1955.

The Montana Land Board is studying a recommendation that it schedule a definite number of lease sales for state-owned oil and gas lands each year.

Board Member Harriet Miller suggests lease auctions be held January 15, April 15, July 15, and October 15. She said elimination of "uncertainties connected with irregular leasing would result in more applications." The board's next sale is slated for May 13. It will be the first since December 19, 1956.

Navy Land Grabs Hit

House committee supports bill to curb big military land withdrawals, wants the Navy to stop exploration program

WASHINGTON.—The Navy's insistence on keeping 800,000 acres of oil lands on the outer Continental Shelf and Interior's failure to insist on release of the area brought sharp criticism from the House interior committee last week.

This was voiced in a report to the House urging passage of a bill to require congressional approval of all military land withdrawals in excess of 5,000 acres. The bill also would give Interior rights to oil and mineral resources under all withdrawn lands except those set aside as naval oil and shale or coal reserves.

The committee also served notice that it will continue to oppose exploration by the Navy with a view to finding new oil reserves. The Navy should not be allowed to go fishing for oil as it sought to do last year on San Nicolas Island, the report said. If it wants more reserves it should have land set aside by the President or Congress—which it hasn't done.

"It is ironic, in the committee's view, that the same defense agency which has pleaded so long in so many forums for an opportunity to explore for petroleum on lands which it controls must at the same time assume the burden, in large part, for blocking the development of what is believed to be one of the United States' richest petroleum-resource areas," the report said.

Costing Treasury . . . This block is barring the Treasury from at least $250,000,000 which would be secured from leasing in the 1,000,000-acre air-warning area on the outer Continental Shelf 30 miles south of New Iberia, La., it charged.

The Navy claims the area is "vitally needed" as an aerial gunnery range, the committee said. But it pointed out that the Navy controls more than 206,000,000 acres in other areas which is said could be used equally well.

The Navy "appears" to take the position that an order setting up this gunnery range provides for the closing of the area to mineral leasing. But if such an order exists it hasn't been produced, the committee said.

A principal argument against relocating the range last year was that it would cost the Navy $2,000,000 a year for extra fuel. But the committee pointed out that bonuses alone from the underlying oil would amount to $250,000,000 or more.

Double talk hit . . . The report charged in effect that Navy is using the "defense needs" angle as a kind of double standard—to support its right to drill on Naval Reserves on the one hand and to prevent development of the disputed area off Louisiana on the other.

The report also hit at the Defense Department and "those responsible in executive office of the President" for permitting the situation to continue. If the Defense and Interior departments won't or can't force Navy to open the lands to leasing, it said, then Congress must.

Canadian Test Hits

British Columbia wildcat flows 15 bbl. in half hour

FORT ST. JOHN.—British Columbia is looking more promising as a major oil-producing province.

Hudson's Bay Oil & Gas Co., Ltd., and Union Oil Co. of California have opened the province's third oil field 60 miles northeast of here, and 50 miles northwest of nearest production.

The 1 Milligan Creek (see map) flowed 15 bbl. of oil in ½ hour from the basal Triassic. Final pipe recovery was 24 bbl. of clean oil with no water. The drill-stem test was taken at 3,691-3,761 ft.

Early strikes . . . Oil production is just 1 year old in British Columbia, although there has long been gas production in the province.

Boundary Lake field was opened in February 1956. This pool now has six wells, and a long southwest extension well. The wells produce from the Triassic.

Later in 1956, oil production was found in Fort St. John gas field. There are now four producing wells—three from Triassic, and one from Permo-Penn.

Since the initial discovery, British Columbia has produced 183,592 bbl. of oil. Daily average is about 1,100 bbl. January was the record month, with a total of 34,556 bbl.

This year should be an important exploratory and development period for British Columbia. Earlier in 1957, 31 rigs set an all-time high for active rotaries running in the province.

Refiners File Nominations

CALGARY.—U. S. refiners have submitted nominations to the Alberta Petroleum and Natural Gas Conservation Board for 98,286 bbl. daily during April. This boosts nominations for the month to 420,032 bbl.

Allowable production rate set for March was 403,884 bbl. daily.

Imperial Oil, Ltd., retains hold on top place in the nominations with an application for 163,100 bbl. daily. British American Oil Co., Ltd., is next with a request for 52,700 bbl. daily.

Shell Oil Co.'s Anacortes refinery is in third place with a demand for 40,400 bbl.

Other U. S. nominations are: General Petroleum Corp., Ferndale, Wash., 38,561; International Refineries, Wrenshall, Minn., 8,334; Lake Superior Refining, Superior, Wis., 5,333; Bay Refining Corp., Bay City, Mich., 4,000; Dow Chemical Co., Midland, Mich., 1,000; West Branch Refineries, West Branch, Mich., 333; Union Oil Co., Cut Bank, Mont., 225; and Phillips Petroleum Co., Great Falls, Mont., 100.

Four Corners Office Set Up

FARMINGTON, N. M.—Shell Oil Co. has established a production division office here to supervise the drilling of as many as 100 wells this year in the Four Corners area.

S. F. Bowlby, Shell vice president who announced creation of the division, said the development program may include 100 wells but "we're not exactly certain right now."

R. R. Robinson is manager of the new division. He formerly was manager of Shell's San Joaquin production division in California. The Farmington production staff will number about 40 persons.

The wells will be drilled in the

Paradox basin and the San Juan basin. Shell has about a dozen producers near southeast Utah's Aneth field in the Paradox. Shell recently joined several other firms in forming the Four Corners Pipe Line Corp. to construct a 60,000-bbl. crude line to Los Angeles.

Alaskan Test Dry

Phillips abandons wildcat after noncommercial shows

ANCHORAGE.—Phillips Petroleum Co. has plugged and abandoned its third wildcat in southeastern Alaska.

The 2 Sullivan went to a total depth of 12,054 ft. It found several shows, but no commercial oil. The well site is just north of Icy Bay on the million-acre tract held by Phillips and its minority-interest partner, Kerr-McGee Oil Industries, Inc.

Phillips and Kermac began the Alaskan drilling program in 1953. In a contract with the Interior Department, they agreed to drill 12 tests over a 10-year period and to spend at least $1,200,000 in the process. The spending commitment already has been met.

The million-acre block is in the Katalla-Yakatega area, near the eastern edge of Alaska's southern shore.

The 2 Sullivan was spudded just 1,200 ft. south of the 1 Sullivan, which also found noncommercial shows. The second dry hole was a stratigraphic test 7 miles from the 1 Sullivan.

Ancient Field Set for Floods

BAKERSFIELD, Calif. — A water flood now in the planning stage promises to revive things for an ancient California field which has been off production for several years.

Vinco, Inc., of Porterville, Calif., plans to make a 2-year water-flood test in the old Sargent field in the extreme southern tip of Santa Clara County.

The company estimates the flood will result in ultimate recovey of 5,000,000 bbl. of low-gravity crude, more than six times the 780,000 bbl. the field has produced in its 96-year history. The project includes treating and injecting facilities, 11 new oil wells, and 1 injection well.

Production from Sargent field dates back to 1860 when crude was mined. An asphaltum refinery was built in 1864. The first well was drilled in the field in 1866. Peak production came in 1909 when the field's output reached 175 bbl. daily.

COSTLY PLATFORM goes up around deep-water well jacket at Shell Oil strike, left, as deck section, right, stands ready to be fitted over the top. It means . . .

Undersea Completions Beckon

NEW ORLEANS. — Shell Oil Co. has a good argument for underwater completions of deep-water wells in the Gulf of Mexico.

The company has installed a wellhead platform over its recent discovery in water 97 ft. deep. Site is about 45 miles south of the coast of Vermilion Parish, Louisiana. The one-well jacket cost about $250,000.

Virtually the only purpose of the platform is to protect the well and permit above-water completion. Besides containing the christmas tree, the costly platform also supports a helicopter landing deck and navigation aids such as lights and fog horn. Underwater completion would make the platform unnecessary.

The Shell structure is in deeper water than any other single-well production platform in the Gulf of Mexico.

Four skirts on the bottom of the template anchor the structure to the gulf floor. The skirts, 17½ ft. square and 15 ft. high, are sunk level with the mud line. The christmas tree is about 45 ft. above the surface of the water and the heliport is about 55 ft. above water.

Some problems . . . The problem of cutting costs in deep water is by no means peculiar to Shell. All offshore operators face the same problem to some degree, and it will become more acute as oil is found farther from shore.

Some companies have tried to lick the problem by drilling in deep water from big permanent platforms. As many as 12 wells can be sunk from a single structure. After development of the field, the structure is used as a production platform.

But drilling wildcats from self-contained platforms is extremely risky. In case no production is established or the field later fizzles, salvaging such a structure would be almost prohibitive because of the cost. Drilling directional holes also is expensive.

Several companies have been planning experiments in underwater completions. Such technique is likely to become common in deep water if and when the workover problem is solved.

The Shell discovery was drilled by Offshore Co.'s rig 54. The same mobile barge has started drilling an offset 1,000 ft. northeast of the discovery.

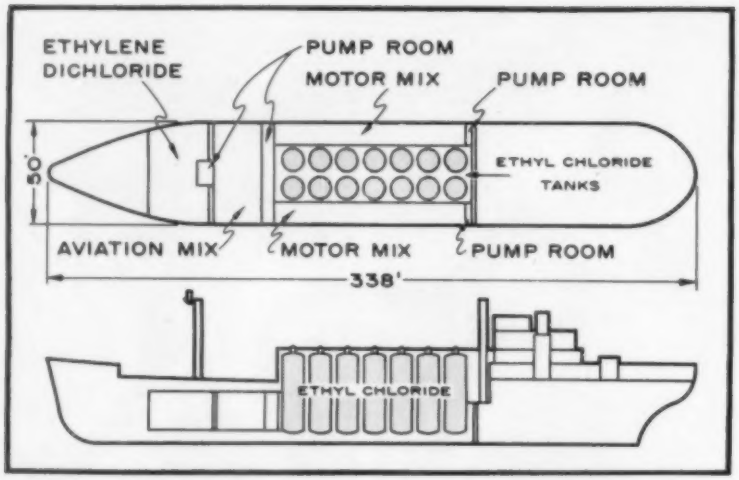
Conoco Drops Third Grade

HOUSTON.—After experimenting with three grades of gasoline in Houston for almost a year, Continental Oil Co. is going back to the two-grade system.

This week the new high-octane Conoco Royal will replace the former premium, Conoco Super, in the company's 27-state marketing area.

Conoco introduced its new super gasoline at a limited number of stations last year while continuing to sell the former regular and premium.

"After studying the results of the Houston three-grade test, we are assured that our new Conoco Royal can serve the requirements of all current automobiles without adding complications for our customers and expense for our dealers and jobbers," explained Harry J. Kennedy, company vice president.



DU PONT will haul TEL one way and pick up raw materials on return trip . . .

Double-Duty Ship Launched

WILMINGTON, Del.—The M. V. "Petrochem" will make her maiden voyage to the Gulf Coast early this month. This will mark the first bulk transport of tetraethyl lead in an ocean-going vessel.

Du Pont's petroleum chemicals division has the ship under charter. It will serve the major Gulf Coast refining market from the company's Chambers Works located on the New Jersey side of the Delaware River, near here.

It is designed for double duty. On the southbound trip, it will deliver 7.5 million pounds or about 14,000 bbl. of finished antiknock compound, both aviation and motor mix. Destination is Du Pont's newly expanded Beaumont distribution point from which TEL is shipped to refiners throughout the Southwest.

On the return trip, the Petrochem will pick up ethylene dichloride at Port Neches, and ethyl chloride at Houston. These are raw materials for TEL synthesis at Chambers Works. A round trip will take less than 3 weeks.

The 6,000-ton vessel is a converted dry cargo ship owned by Valentine Chemical Carriers, Inc., of Cradell, N. J. At the Bethlehem Steel Co. shipbuilding division's Brooklyn yards, it underwent complete rebuilding for this specialized service. Below decks, seven heavy steel tanks will handle TEL and ethylene dichloride. These tanks are welded to the ship's ribs, and their surface is available to inspection.

Five cofferdams divide the ship into six liquid-tight compartments, with a separate bilge system for the cargo section to prevent contamination of normal bilge in event of spillage. Every 3 minutes the air is changed completely in the below-deck spaces, and air samples can be taken from the deck.

The ethyl chloride will be handled under pressure in 14 vertical vessels which project above the deck. They will handle 3 million pounds of raw feed stock.

As an added measure, the Petrochem's unloading facilities are made of heavy, leakproof swingline connections rather than conventional hose lines. All tanks are thoroughly purged on discharge and all vented vapors pass through a scrubber to remove any traces of contaminants.

They're Almost Gone!

If you want an extra copy of "Oil Hits Back," better order it today. Demand for reprints of this 16-page special section has been so great that only a few remain.

The section appeared in the March 18 Oil and Gas Journal. It's been used widely since then to defend the oil industry against charges of price gouging, excessive profits, and lack of public interest. Orders, in fact, have ranged in size from single copies to shipments as large as 23,000.

If you need extra copies, wire, phone, or write:

Reader Service Department
The Oil and Gas Journal
Box 1260, Tulsa

Seaton says: *Government Can't Regulate Prices*

WASHINGTON. — Congress was told last week some facts of life that oil men have known all along.

The federal Government has no authority to regulate prices. Any effort of the Middle East Emergency Committee to adopt a plan to hold the price line would have been an outright violation of law.

Responsibility for justifying oil price increases lies directly on the industry, Interior Secretary Fred A. Seaton said in a letter to Sen. Joseph C. O'Mahoney, chairman of the joint judiciary-interior subcommittee probing the European oil lift.

"I have absolutely no legal authority to demand that the oil industry furnish me with detailed cost analyses and other facts upon which to base a reasonable conclusion as to whether the increased price of these products was warranted," he declared.

Backed by Brownell . . . Seaton backed his letter with an opinion from Atty. Gen. Herbert Brownell, Jr.

"Price fixing among competitors in an industry is a per se violation of the antitrust laws," Brownell held.

There is no mention of prices anywhere in the voluntary agreement on foreign oil supply under which the MEEC was set up, Brownell pointed out.

Stabilization of domestic prices would require participation by the bulk of domestic producers, refiners, and retailers, he said.

"The result would be a committee so different in composition and purpose from that envisioned in the voluntary agreement as to require a new plan. Such new plan would be without authority under the 1955 Defense Production Act amendments.

"Since there is, in my opinion, no authority for a price arrangement by MEEC members, it is unnecessary to go into the question of antitrust immunity . . . ," Brownell concluded.

Why the letter . . . Seaton's letter was an answer to the charge raised during the oil-lift hearings last month that he had failed to make any effort to induce the MEEC to hold prices down.

That charge was made by Sen. Estes Kefauver of Tennessee. He argued that approval of the MEEC plan of action should have been based on a voluntary agreement to maintain the pre-Suez price level.

"I was never certain whether Sen-

ator Kefauver was inquiring about an agreement on the part of the MEEC companies to hold the price line, or an appeal by me to the major oil companies to hold down prices," Seaton observed.

Alberta Field Plant Eyed

CALGARY.—Shell Oil Co. officials are seeking to reach an agreement with other operators and land owners in the Okotoks area, 25 miles south of Calgary, which would permit construction of a gas-processing and sulfur plant.

Paul Kartzke, Shell vice president in charge of exploration and production, said if the agreement can be reached his company may construct a plant in the Okotoks area capable of processing 30,000,000 cu. ft. of gas and 300 tons of sulfur daily.

Shell also is expanding its plant at Jumping Pound, a major supplier of Calgary's natural-gas requirements, in a project which will boost its capacity from 60,000,000 to 90,000,000 cu. ft. daily.

NPC to Study Production

WASHINGTON.—A 24-man committee has been appointed by the National Petroleum Council to study production capacity of the principal producing areas of the U. S. as of January 1, 1957.

The study, requested by the Department of Interior's Oil and Gas Division, will also estimate the length of time this capacity could be sustained without further drilling, how fast it would decline, and the number of wells that must be drilled to maintain it.

L. F. McCollum, president of Continental Oil Co. of Houston, is chairman of the committee. Morgan Davis, executive vice president of Humble Oil & Refining Co. of Houston, is vice chairman.

Navajo Lands Put on Sale

WINDOW ROCK, Ariz.—Oil and gas leases on nearly 90,000 acres of Navajo Indian Reservation land in northwestern New Mexico will be sold in a series of sales starting this month.

The land includes 46,882 acres in McKinley County and 43,011 acres in San Juan County. The tracts lie west and south of the San Juan basin gas fields and Bisti oil production in San Juan County.

The sale April 25 will cover 33,455 acres on 210 tracts. The May 16 sale will involve 30,244 acres, and the final sale June 6 will offer 26,372 acres.

Processing briefs

Carbide & Carbon Chemicals Co. will double production of acrylonitrile at its Institute, W. Va., plant in 1958. Behind the expansion is the increasing demand for acrylic fibers, high-impact resins, tough Buna-N type rubber, and new derivitives.

Construction will begin June 1 at the new alkylation unit for Standard Oil Co. of Ohio's Cleveland refinery. A $2,400,000 contract was awarded to Arthur G. McKee & Co., Cleveland. The new 5,475-bbl. unit will use the M. W. Kellogg Co. process. Feed stock will be butane gases from the 52,000-bbl. refinery's catalytic cracking unit. Completion is set for May 1, 1958.

New catalytic reformers are planned for the Richmond and Bakersfield refineries of Standard Oil Co. of California, Western Operations, Inc. Completion is set for mid-1958. The Richmond unit will be similar to the twin 20,000-bbl. reformers built at the Richmond and El Segundo plants 2 years ago. The Bakersfield reformer will have a 3,000-bbl. capacity.

Shell Oil Co. has awarded a construction contract on a 2,400-bbl. sulfuric acid-alkylation unit at its 50,000-bbl. Anacortes, Wash., refinery. The job went to Fluor Corp., Ltd., of Los Angeles. Work is scheduled to start in October, with completion next year.

A natural-gas processing plant will be built near Lovington, N. M., by Tennessee Gas Transmission Co. The absorption-type plant will have initial capacity of 10,000,000 cu. ft. of gas per day. It will produce about 43,000 gal. of propane, butanes, and natural gasoline per day. The plant is expected to go into operation in late 1957 or early 1958.
rich.

Cit-Con Oil Corp. will increase paraffin-wax production by 25 per cent and light-oil production by 20 per cent at its Lake Charles, La., lube plant. The expansion will be part of a $4,000,000 construction program by the Cities Service and Continental Oil Co. subsidiary.

The Texas Co. has completed new product control laboratories at its Port Arthur, Tex., refinery. The labs are designed to process more than 1,500 samples daily. One of the two new buildings will house the general, grease, and gas analysis sections of the analytical lab. The other will house the heavy oils, light oils, octane, and oxidation sections of the testing lab.

Anderson-Prichard Oil Corp., Oklahoma City, will increase its refining capacity by 7,500 bbl. daily in June when it completes its two-prong building program.

Apco is adding a reactor regenerator section to its catalytic cracking unit and rebuilding its gas-recovery system at Cyril, Okla. This will boost capacity from 10,000 to 12,500 bbl. daily. A new crude distillation unit is being built at the Arkansas City, Kans., plant. This will increase capacity from 20,000 to 25,000 bbl. daily.

Also for Refiners . . .

Refiners got this look at the future during W.P.R.A. meeting: 107 premium and 98 regular by 1965 with a 101 weighted average for all gasolines. This quality jump will cost refiners 60 cents a barrel (P. 73) . . . Petrochemicals are still growing after 11 per cent gain last year . . . Urea dewaxing of lube oils is proving practical. Big advantage: It requires only ordinary temperatures (P. 74) . . . Ultimate success of federal highway program will depend on how much asphalt is used (P. 75) . . . The Detroit marketing strikes have spread to one Michigan refinery and are causing another to cut back. Aurora's Detroit plant has been struck and is closing down. Socony Mobil is cutting back production at its refinery near the city . . . Refiners serving Los Angeles are facing a fight to prevent changes in motor-fuel blends as a possible smog-control measure (P. 78) . . . Conoco is dropping its experiment with three grades of gasoline and will now market only two grades (P. 85) . . . Magnolia is putting the finishing touches on a $25-million expansion program at its Beaumont plant . . . First gasoline from gilsonite is being turned out at plant near Grand Valley, Colo. (P. 92).

PLUS THESE TECHNICAL FEATURES: A new asphalt plant is charging Boscan crude at the rate of 5,000 bbl. daily for Texas Asphalt & Refining Co. on the Houston Ship Channel (P. 201) . . . Cost-imating (P. 203) . . . The Foreman's Page (P. 205) . . . and Refinery Construction Index (P. 208).

Offshore: Legal Jungle

● Operators face maze of problems with admiralty law; Congress as a result is now ready to rewrite the rules

WASHINGTON.—If workers on an offshore drilling platform drop their tools in a demand for higher pay is it mutiny on the high seas? Or is it just a strike, as it would be on land?

That is just a sample of the vexing legal problems facing offshore operators. There are many others stemming from the opening of the submerged lands to oil and gas leasing.

New laws will be needed to adapt old laws to new conditions on the Continental Shelf. Congress is ready to deal with them. Last week a House judiciary subcommittee was named to study the problem and suggest remedies. Rep. Edwin E. Willis of Louisiana, who forecast this need when the tidelands and shelf acts were passed in 1953, will head the group.

Oil operators on shore are governed by state law. Activities at sea come under federal law. Where one leaves off and the other picks up is a big problem. And there are situations where both might apply. That raises the possibility that a man might be tried twice in court for the same offense.

No serious legal question of this nature has come up so far. But the industry, the states and Congress alike are eager to have the matter cleared up quickly.

Who has authority? . . . Offshore operators find that their problems start at the water's edge.

The states, of course, have authority over offenses committed within their boundaries. Question No. 1: Does that authority cover the water as well as the land area? Question No. 2: Does the federal Longshoremen's Compensation Act supplant state compensation law which otherwise might apply?

When operators get beyond the state boundary they find different ground rules apply. They come under federal laws applying to navigation and crimes on the high seas.

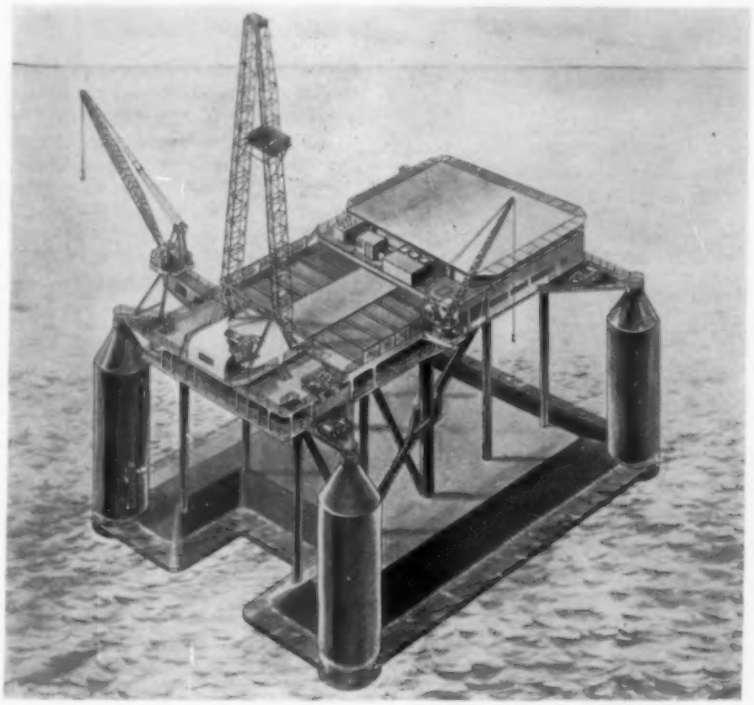
That is where the question of whether a strike is a strike or a mutiny comes up. If land workers walk out it is a strike. If men aboard a ship strike it is mutiny.

The answer will depend on whether drilling platforms are held to be vessels or artificial islands or fixed structures. If Congress doesn't define them the courts may have to some day.

Other problems . . . There are other big questions facing operators, too. Some have to do with contract law and whether the building and operation of drilling platforms is subject to state or federal law.

More problems arise with respect to insurance. Operators on the submerged lands find themselves in the uncharted sea of marine insurance when they seek to protect themselves against damage or liability on their offshore equipment.

Under the Outer Continental Shelf Act, the area seaward from the state boundary is under the exclusive control of the United States. But the act also provides that the civil and criminal laws of the adjacent state are to be applied by the federal District Court in cases arising out of operations in the shelf area, where such laws are not in conflict with the federal statutes. State laws can't be changed because they would encroach on the higher federal law. But the federal laws can.



Deep-Drilling Barge Started

NEW ORLEANS.—Louisiana Offshore Drilling Co. will make a big splash in the Gulf of Mexico with completion of its new submersible-type drilling barge next fall.

The barge is designed for water as much as 65 ft. deep. It will be equipped with a rig capable of drilling to 20,000 ft. or deeper.

The company announced last week that Ingalls Shipbuilding Corp. has started construction of the new vessel. Delivery is set for September.

Designed by Friede & Goldman, New Orleans, the barge will have a "spread-footing" type of hull. Cylindrical caissons located at the four corners will lend stability while raising and lowering the vessel.

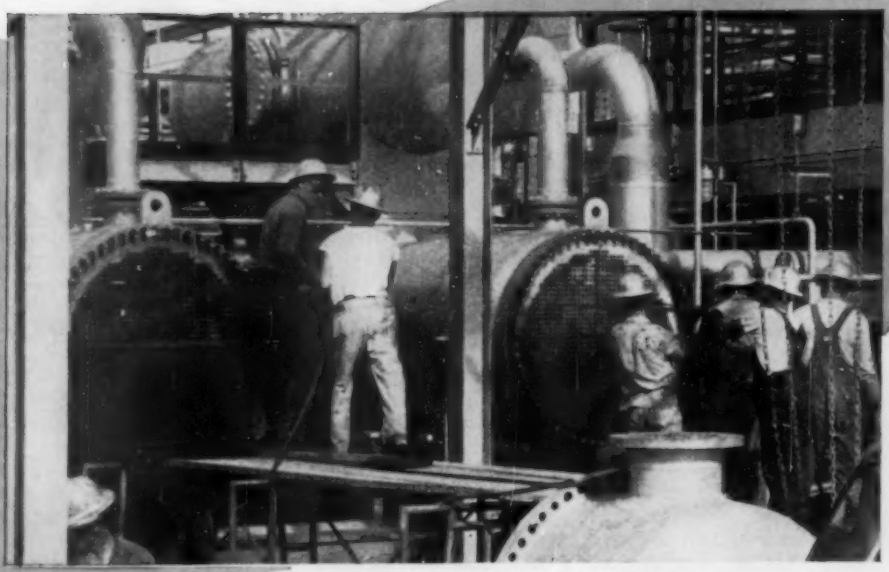
The barge will be sunk to the gulf floor at drilling location merely by flooding the big steel compartments. Pumping water out of the vessel will refloat it.

Plans call for no external paint on the hull since cathodic protection will be used exclusively to combat corrosion.

Measuring 180 ft. by 151 ft., the vessel will have the traditional drilling slot rather than a cantilevered deck for drilling over the side.

Nalco TREATMENTS

can prevent plugging, put an end to costly turbining of heat exchanger tubes



Turbining operation means lots of downtime, lots of labor . . . two costly situations you can avoid with Nalco treatment.

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Southland Hits Snag

Expansion at Memphis, new plant in Florida face delay

MEMPHIS.—Lagging materials deliveries and prolonged rains have slowed Southland Co.'s ambitious expansion of its Memphis refinery.

Completion date for the first phase of the program has been moved back 6 months to June. The first phase calls for doubling crude capacity of the 6,000-bbl. plant. Capacity was then to be pushed on up to 22,000 bbl. by October. But completion of this second phase might also be delayed.

Southland bought the Memphis plant from Delta Refining Co. in June 1956. It now has a 6,000-bbl. crude unit, a 1,000-bbl. vacuum distillation unit, a 3,100-bbl. Thermofor catalytic cracker, and a 250-bbl. cat polymerization unit.

Southland plans to build a new alkylation unit and to install a larger kiln to hike capacity of the cracker. It will boost crude capacity by combining several heaters and adding a new one, expanding cooling and heat-exchanger sections, and adding a new boiler and tower.

Most of the alkylate will be blended into motor gasoline.

Florida plans . . . E. Constantin, Jr., Southland president, said a new plant planned by an affiliate, Southland Oil Co. (Fla.), has also been delayed.

The plant will be located near Black Point, Fla., just southeast of Tampa. Crude capacity will be about 15,000 bbl. daily. The plant is expected to operate primarily, if not entirely, on imported crude. Construction has been delayed by high tanker rates and by lack of steel.

Louisiana Trims Allowable

BATON ROUGE.—The April oil-production allowable in Louisiana has been set at 919,405 bbl. daily. This is a cut of 71,237 bbl. per day from the record allowable in March.

Conservation Commissioner John B. Hussey said the cutback is primarily due to renewed competition from Middle East oil.

The March allowable of 990,642 bbl. was Louisiana's all-time high. With the new cutback in effect the state will still be producing at a rate far exceeding the 749,282 bbl. daily set last October, before the Suez crisis.

April allowables by districts are: Houma, 221,172; Lafayette, 181,750; Lake Charles, 81,652; New Orleans, 291,056; Monroe, 73,689; and Shreveport, 70,086.

Pipeline briefs

Pacific Gas & Electric Co. plans to lay several hundred miles of gas lines during 1957. Hood Construction Co. is completing the first project, 24 miles of 12-in. and 4 miles of 10-in. from Hinkley to Victorville, where gas will be sold to two large cement plants.

Engineers Limited Pipeline Co. is laying 37 miles of 20-in., 37 miles of 18-in., and 3 miles of 16-in. to transport gas from the Willows area to Sacramento. Completion is due in June. The major part of the program has not been contracted. This includes 138 miles of 34-in. to complete the looping of its Topock-Milpitas system, and 173 miles of mostly 12-in. between Corning and Eureka to connect P. G. & E.'s Humboldt division with its integrated system.

The first British pipe from an order of 200,000 tons of 30-in. for 600 miles of Trans-Canada Pipe Lines, Ltd., has arrived in Halifax, N. S. The pipe, fabricated by South Durham Steel & Iron Co., Ltd., will be shipped to Manitoba by rail for laying on the line east of Winnipeg.

Survey crews have started work on the 600-mile Four Corners Pipe Line from fields near the common corner of New Mexico, Colorado, Utah, and Arizona. The job was contracted to San Juan Engineering Co., Farmington; E. H. Schmidt & Associates, Inc., Tulsa; and McIntire & Quiros, Inc., Los Angeles. The 16-in. line is to be started this month and completed by the end of the year.

Producers Pipelines, Ltd., a new company, has purchased Westspur Pipe Line Co., which has the same ownership and operates a crude-pipeline system in southeastern Saskatchewan.

The new firm, which has a federal charter, can better handle problems of jurisdiction involving the provincial and federal governments. Its first project is extension of the gathering system to Hastings, Carduff, and Glen-Ewen fields, which will be linked by a 6-12-in. line to the Westspur Alida terminal.

Northern Natural Gas Co. has laid a $65,662,000 expansion program before the Federal Power Commission to increase capacity 149,000,000 to 1,345,000,000 cu. ft. daily. Northern Natural plans to increase deliveries to existing customers by 47,000,000 cu. ft. daily and add 213 communities in South Dakota, Nebraska, Wisconsin, Minnesota, and Iowa.

Niagara Mohawk Power Corp., Syracuse, N. Y., plans to build 322 miles of transmission and distribution lines to expand service in New York this year. Lines will range from 2 to 18-in.

Northern Illinois Gas Co. will spend $21 million on construction this year. This compares with $17.4 million during 1956. The spending is a part of a long-range expansion of $75 million over the next 4 years. A 45 per cent increase in its natural-gas supply is planned through a project of Natural Gas Pipeline Co. of America now before the Federal Power Commission. To augment its long-range supplies, the company has organized NI-Gas Supply, Inc., to drill for gas on the Gulf Coast and in Texas and Oklahoma.

Consolidated Natural Gas Co. has budgeted $74 million for construction this year to increase gas deliveries. The company also will engage in a 5-year, $50 million joint exploration program on the Louisiana Gulf Coast with Mississippi River Fuel Corp.

Also for Pipeliners . . .

Great Lakes Pipe Line plans to push its 5,000-mile products system farther north, reaching Eau Claire and Superior, Wis. (P. 80) . . . Growing markets in the Rockies and Pacific Northwest are behind Salt Lake Pipe Line's expansion of its products and crude system (P. 83) . . . Both the U. S. and Britain are expected to strongly endorse a new big-inch crude line out of the Middle East. Such a line was discussed in Bermuda by President Eisenhower and Prime Minister Macmillan. The most likely route: North from the Persian Gulf in Iraq, then west through Turkey to the Mediterranean (P. 95) . . . One of the keys to Caltex's developing central Sumatra is a 30-in. crude line to tidewater (P. 98).

PLUS THESE TECHNICAL FEATURES: River crossings are speeded up with a new machine for drilling shot holes in rocky river beds (P. 206) . . . and Pipeline Patrol's construction report (P. 211).

Record Units in at Magnolia

DALLAS.—Magnolia Petroleum Co. will finish off a huge $25,000,000 expansion program at its big Beaumont refinery early this month.

Last construction will be flanged up when the company places on stream a 28,000-bbl. Thermofor catalytic cracking unit . . . the biggest of its type in the world.

The big cat cracker towers 330 ft. high and its foundation pilings extend 90 ft. below ground.

It is one facet of a five-sided expansion kicked off in August 1955, primarily to boost output of high-octane and distillate fuels.

However, the expansion also has hiked the refinery's crude capacity from 180,000 bbl. daily to 205,000 bbl. daily. Other equipment already completed and in operation under this program includes:

. . . **World's largest Sovaformer,** designed to upgrade 20,000-bbl. of naphtha a day into 100-octane gasoline. The unit also is the first Sovaformer in the Southwest.

. . . **L.P.G. fractionating section,** which will process up to 26,700 bbl. daily. Butane and propane products are 95-plus per cent pure.

. . . **Feed-preparation system** to recover naphthas from straightrun gasoline as charge for Sovaformer.

. . . **Existing T.C.C. unit** revamped to enlarge its capacity. The reactor of the unit, which first went on stream in 1953, was remodeled to permit it to process an added 4,000 bbl. daily of gas oil.

Minor revamping of the interior of a distillation tower doubled its capacity.

Work on the new cat cracker, the Sovaformer, the feed-preparation system, and that on the older cracker was done by Bechtel Corp. Fluor Corp. was contractor for the L.P.G. fractionating plant.

No lull in expansion . . . Despite the end of this big program, there will be no break in expansion work at the Beaumont refinery in the foreseeable future.

Bulldozers already are at work on plant grounds, clearing and preparing marshland sites for new process units. The cost of these probably will exceed the $25,000,000 just spent.

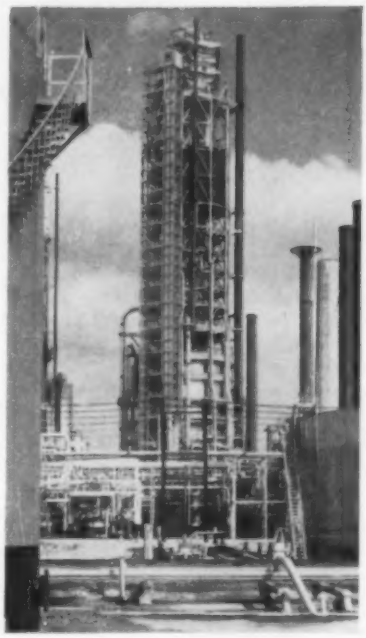
On these sites, Magnolia will erect:

. . . **A whopping 100,000-bbl.** atmospheric crude still.

. . . **A 32,000-bbl.** vacuum unit.

. . . **A hydrogen-sulfide** recovery system.

. . . **A 30,000-bbl.** Sovaforming unit.



THE WORLD'S Biggest T.C.C. unit.

. . . **A second alkylation unit**—an 8,000-bbl. plant of the sulfuric acid type.

. . . **A third treating plant** with a capacity of 20,000 bbl. daily. This will be used in conjunction with the Sovaforming to upgrade quality of middle distillates.

. . . **High-pressure** gas-handling equipment.

. . . **A lube blending** and packaging plant.

. . . **A 200,000-bbl.** floating-roof tank (believed the largest in the Sabine area).

The new distillation units will charge topped crude and replace old stills which are to be torn down. The planned facilities will be built mainly for improving plant products. They won't add much to the plant's crude-charge capacity.

Oil-Lift Program Extended

WASHINGTON.—The emergency program for supplying oil to Europe was given a 2-month extension last week by Felix E. Wormser, assistant secretary of the interior.

The extension was not unexpected *(The Oil and Gas Journal, March 25, page 113).* The delay in getting Suez shipping back to normal and the limited movement through the temporarily repaired Iraq pipeline make continuance of the oil lift necessary.

Wormser extended the three schedules permitting rearrangement of tanker schedules. He did not continue a fourth schedule permitting changes in domestic pipelines. No action ever was taken under this schedule.

A further extension of the oil lift will be ordered if the situation has not cleared up by the end of May, Wormser indicated. But if the emergency ends before then, the program will be ended "in an orderly manner," he said.

Gilsonite Tested

Unique plant will produce gasoline, coke, fuel oil

GRAND VALLEY, Colo.—The first gasoline produced commercially from a solid material is being turned out at American Gilsonite Co.'s new $12-million plant near here.

Tests began this week at the unique plant which converts gilsonite into gasoline and metallurgical coke. The refinery will go on stream about June 1, and the 86-octane unleaded gasoline will be marketed in the Grand Junction area of western Colorado.

With a daily charge of 630 tons of gilsonite, the plant will produce 1,300 bbl. of gasoline, 300 bbl. of fuel oil, and 265 tons of high-purity, electrolytic coke.

How it's done . . . Gilsonite is crushed to particles of ¼-in. and less, and floated in water through a 72-mile pipeline from mines at Bonanza, Utah, to the refinery.

The pipeline was completed early in March by Engineers, Ltd. It transports about 700 tons of gilsonite a day in slurry composed of 35 per cent solids and 65 per cent water.

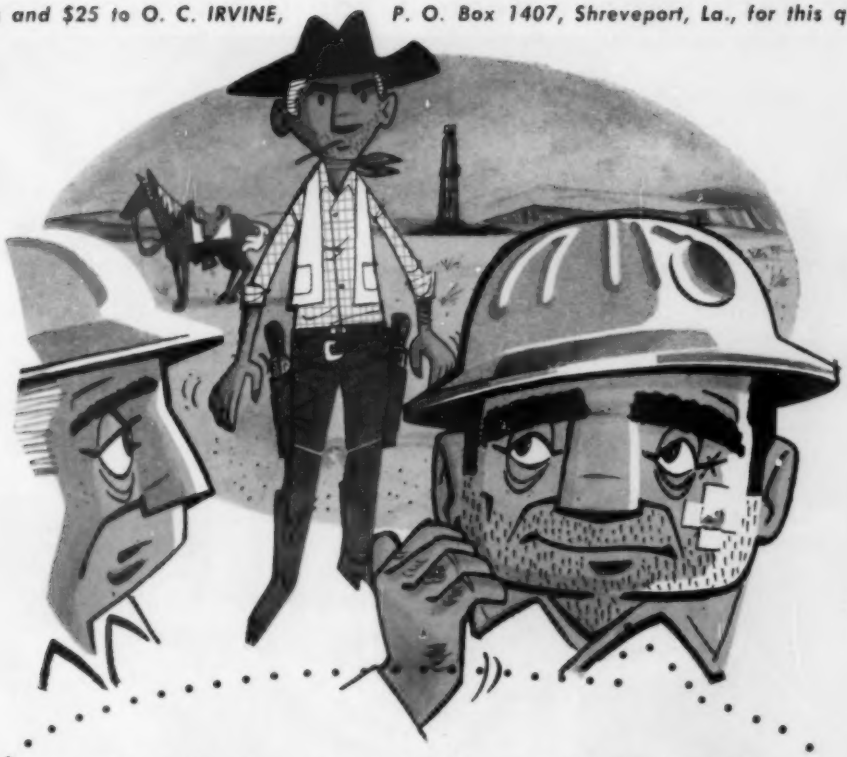
Delayed cokers at the plant produce an unusually high-grade coke. The gasoline is a byproduct of the coker. The overhead from the coker is fractionated and the gasoline fraction is piped to a two-stage U.O.P. Platformer to produce the gasoline.

The plant will be tested later to determine if it can be used to refine oil from nearby shale deposits.

Reserves . . . Utah gilsonite reserves cover an area 10 miles wide and 60 miles long. The reserves are estimated at 16 million tons. The company claims this is equivalent to about 90 million barrels of crude oil—enough to keep the plant in operation more than 50 years.

The plant site was chosen because of rail facilities and a market area for the gasoline.

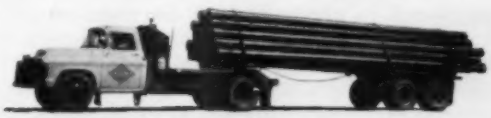
Congrats and $25 to O. C. IRVINE, P. O. Box 1407, Shreveport, La., for this quip.



"Sez he's good at perforatin'!"

Oil industry authorities forecast more wells and more footage as the year progresses . . . over 59,296 new wells are expected in response to spiraling demands for oil.

Lone Star Steel is completely attuned to this new tempo . . . and is rushing construction of a new open hearth furnace and stretch-reducing mill. Eventually, Lone Star will produce more fine steel . . . and more fully-normalized API casing, tubing and line pipe for our friend and neighbor, Joe Roughneck, heart of the oil and gas industry. Depend on Lone Star . . . because Lone Star is on the grow!



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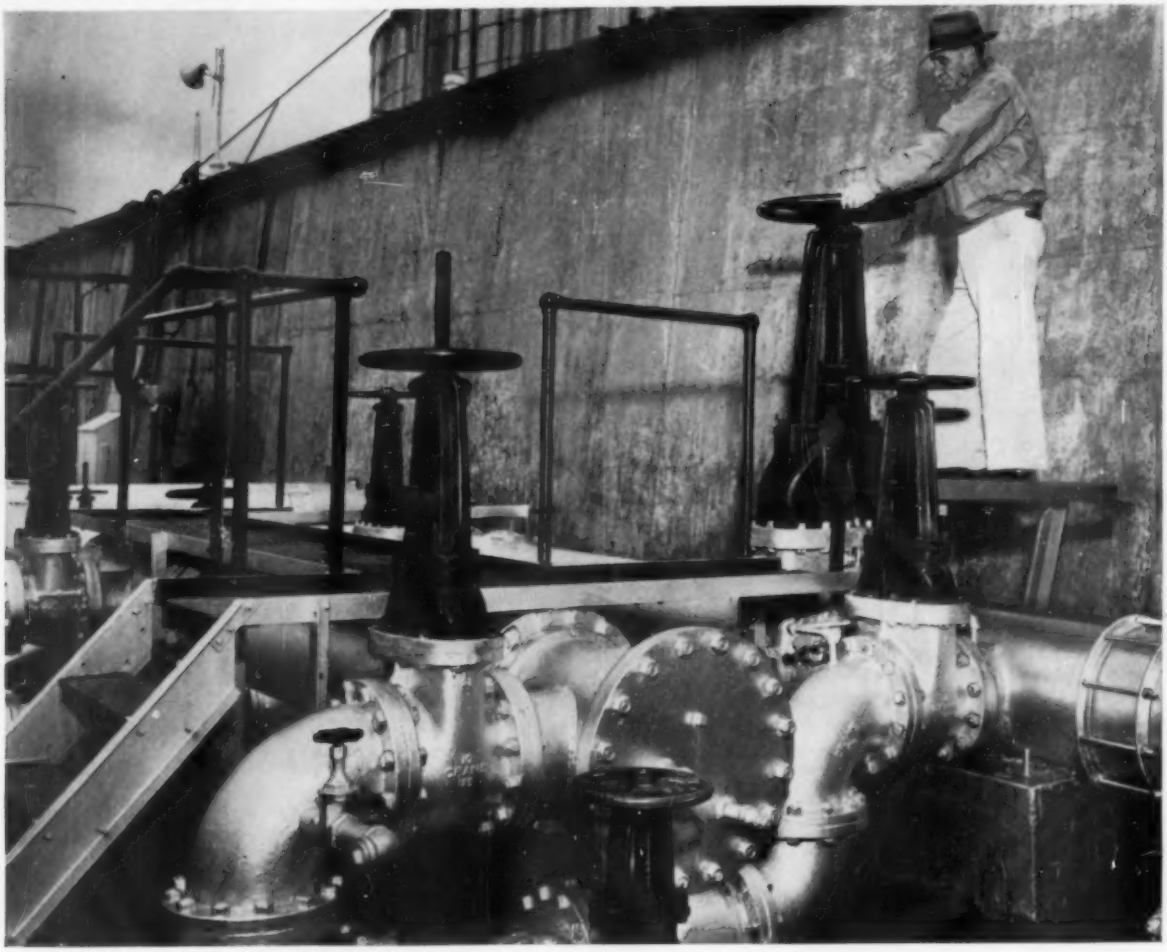
Another Performance Record for Crane Iron Body Valves



36 years in a busy marine terminal —these Crane valves never in need of repairs

Installed in 1920, the Crane iron body gate valves in this fuel oil suction manifold still have a cost-free service record. To date, not one has needed more than normal stuffing box maintenance.

The General Petroleum Corp. (owner of the installation) marine terminal in Seattle is a big, busy place—no "soft berth" for valves. The big valve, for example, is operated an average of 6 or 7 times daily. Yet, like all other valves in the manifold, it remains completely leak-free and trouble-free.

Outstanding performance? Yes, but not unusual for Crane iron body gate valves. You will find them scoring similar service records in every industry. They're strictly quality-made to give above-average performance at low ultimate cost.

Current model Crane 125-pound iron body gate valves with every desirable feature are available in patterns and sizes for all needs. Next time your Crane Representative calls, be sure to ask him about these valves. Or write to address below for complete information.

You may spot cost-saving ideas in this book of "Valve Performance Facts"—32 case histories throughout industry. Ask your Crane Representative or write for a copy.

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U. S. Backing New Line

● **Strong American-British financial and diplomatic help for Middle East artery to bypass Suez is now emerging; it's one result of Eisenhower-Macmillan Bermuda talks**

THE United States Government is giving its blessing—still unofficial—to a third big Middle East pipeline now being planned.

Washington goes a step further than that. It is hinting pretty broadly that oil companies can count on the official weight of both the U. S. and Great Britain if it is needed to give such a pipeline "international status."

These views emerged last week after officials of the world's eight largest oil companies met in London to talk about the best way to build a new outlet for Middle East crude *(The Oil and Gas Journal, March 25, page 117)*.

Here are the latest developments:

... **President Eisenhower** and British Prime Minister Macmillan discussed such a pipeline at their Bermuda meeting.

... **Secretary of State** John Foster Dulles said later in Washington that it might be necessary to give such a pipeline "some kind of treaty protection."

... **Detailed studies** of possible routes, supplies, costs, etc., of a major oil pipeline are now being made by committees appointed by the eight companies which met in London.

Until those committees decide which of several proposed projects would best do the job, little is likely to be done. But it is doubtful that much time will be wasted in making these decisions.

The route that seems to be receiving the most support would take the line north from the head of the Persian Gulf in Iraq and then west through southern Turkey to the Mediterranean. Eventually, other Middle East producing countries like Saudi Arabia, Iran, and Kuwait could be joined to the system.

This would mean a line of at least 900 to 1,000 miles. The still unanswered question of just who would use the line has a great deal to do with its size and eventual cost.

The companies have discussed twin lines of 30-in. or a single line of 40 or 42-in. pipe. Cost estimates range all the way from $500 million to $800 million. There are almost as many variable estimates in capacity—from 500,000 to 1,200,000 bbl. daily.

Government interest . . . Comments made by Secretary Dulles in Washington last week confirmed the official interest of both the U. S. and Britain in any such project.

He said that planning for both the pipeline and increased tanker construction is going ahead under the normal commercial desire of oil companies to meet increasing demand for oil.

Because of the cost of a large pipeline system, he added, companies might have "an understandable reluctance" to take such a commercial risk without political guarantees.

Dulles said that an international status for a pipeline would prevent the countries through which it passes from "arbitrarily interfering" with its operation.

The interested companies have considered offering the governments of both the oil producing transit countries an interest in such a line in an effort to secure its political stability.

There have been suggestions that the line be tied in with the Baghdad Pact since both Iraq and Turkey are members. This, however, would probably not set well with Saudi Arabia, which opposes the pact.

Still a third proposal is for an entirely new concept of international contracts and agreements to be administered by the United Nations.

Ghawar Gets 12-Mile Stepout

WITH a newly completed "stepout," Arabian American Oil Co. has extended the 140-mile-long Ghawar field in Saudi Arabia another 12 miles to the north.

The company disclosed last week that its latest well is being completed 12 miles to the north-northwest of the nearest production in the Ain Dar area of the huge Ghawar trend.

The well, Ain Dar 56, was completed at 7,120 ft. in the "D" member of the Arab zone after it was drilled to a total depth of 7,325 ft.

The "D" horizon is productive in Ghawar, Abaiq, and Damman fields, and was recently found productive at Khursaniyah. The new well will produce from about the same depth as the other Ain Dar wells to the south.

Ain Dar 56 is 55 miles southwest of Aramco's headquarters at Dhahran. The company said more geophysical work is being done in the area and further drilling is planned to evaluate the find.

At one time the big Ghawar field was a series of four fields in a north-south trend over 140 miles. Aramco conceded only in the past 2 years that it is actually one long field. Ghawar has about 75 wells and last year accounted for about 670,000 bbl. daily of Aramco's production.

Khursaniyah . . . On the northwest coast where Aramco made its wildcat discovery at Khursaniyah almost a year ago, the stepout procedure hasn't proved quite so successful.

Khursaniyah 2, drilled 4 miles north-northeast of the discovery is a dry hole. Aramco said last week it was being completed as an observation well.

Drilled to a total depth of 7,885 ft., the well has defined the northern limits of the field. The "A," "B," "C," and "D" members of the Arab zone, all productive in the discovery, contained water in the second well.

The third test is being located 3 miles south-southeast of Khursaniyah 1. This is about 80 miles northeast of Dhahran.

Philippine Wildcat Spudded

Standard Vacuum Oil Co. spudded its first deep test, the second well to be drilled in the Cagayan Valley of northern Luzon, in the Philippine Islands last week.

The test was started just south of the juncture of the Cagayan and Chica rivers near the village of Faire, 225 airline miles northeast of Manila. The well is about 40 miles north of Tumauini 1, the Philippine Oil Development Co. test which was abandoned last year at 10,414 ft.

The Faire 1 is being drilled on one of eight Stanvac concessions which total 966,000 acres. Santa Fe Drilling Co. is drilling the well.

World Output Rebounds

● U. S. and Venezuela help fill Middle East vacuum as January production climbs back toward pre-Suez levels

THE free-world oil industry nearly erased crude production losses in January.

Total output of 14,770,500 bbl. daily was up 403,800 bbl. daily over December and was within 2.9 per cent of the October level, 15,217,800 bbl. daily. October was the final month of full production before the closing of Suez Canal and Iraq-Mediterranean pipelines disrupted supplies.

Despite some gains, Middle East production remained severely restricted. This loss was nearly made up by further increases in United States and Venezuelan production. Here was the picture:

... **Total free-world foreign** output rose 300,800 bbl. daily to 7,290,500 bbl. daily. This was 88.4 per cent of October output of 8,251,800 bbl. daily.

... **Middle East production** gained 216,800 bbl. daily to 2,645,700 bbl. daily. But this was still only 68.3 per cent of the October level of 3,873,500 bbl. daily.

... **Venezuelan output** increased another 70,400 bbl. daily to a record 2,792,000 bbl. daily. Compared with October, the country's production was up 256,000 bbl. daily, or 10.1 per cent. It was a gain of 13.7 per cent over the 1956 yearly average of 2,456,800 bbl. daily.

... **U. S. output reached another peak** of 7,480,000 bbl. daily by gaining 103,000 bbl. daily. This brought the total domestic increase since the Middle East tie-up to 514,000 bbl. daily.

Persian Gulf producers gain ... Iran had the biggest gain of any single Middle East country.

Iranian output rose 133,000 bbl. daily, or 25.4 per cent, to 657,000 bbl. daily. Much of this crude was delivered to the 205,000-bbl. Bahrain refinery. The plant's normal supply of Saudi Arabian crude was cut off when the Saudi Government banned shipments to Britain or France. Bahrain is a British-protected shaikhdom.

Kuwait's output rose 90,000 bbl. daily to 910,000 bbl. daily. Saudi Arabia was the only major producer to decline. Output fell 25,100 bbl. daily to 665,200 bbl. daily. Deliveries at the Sidon, Lebanon, terminal of Tapline were 307,900 bbl. daily, or 46.3 per cent of total production.

Iraq had a slight gain. But it continued to be the worst off of any major producer in the area. Output of 226,800 bbl. daily was 29.6 per cent of October. Mosul Petroleum, the Iraq Petroleum Co., Ltd., affiliate in northwestern Iraq, had a next-to-nothing output of 2 bbl. daily.

Europe strains for crude ... The small producing countries in Western Europe increased their total output by 3,700 bbl. daily for a record 225,800 bbl. daily. This was a gain of 12,800 bbl. daily over October.

The United Kingdom had the highest production for any month since the end of World War II. Output from five small fields in the Midlands averaged 1,600 bbl. daily. Most of the gain came from Egmanton field, discovered in 1955.

Russian output growing ... Crude production in the Soviet Union may have been as high as 1,810,000 bbl. daily. Output could have been around this level if Russian reports are accurate that production averaged 1,680,000 bbl. daily in 1956 and will average 1,940,000 bbl. daily this year. The data published by the Soviets could possibly include condensate.

The Romanian Government claimed to be producing 220,000 bbl. daily early in the year.

TREND OVER LAST YEAR

1956—	Western Hemisphere less U. S.	Middle East	Total non-Communist countries
January	3,359.7	3,381.8	7,350.7
February	3,426.2	3,415.7	7,453.4
March	3,471.2	3,624.3	7,713.8
April	3,320.5	3,736.6	7,690.8
May	3,356.5	3,793.9	7,788.1
June	3,519.1	3,713.7	7,871.7
July	3,549.8	3,806.1	7,996.6
August	3,618.2	3,685.8	7,965.6
September	3,637.2	3,721.8	8,019.3
October	3,688.3	3,873.5	8,251.8
November	3,760.8	2,142.8	6,544.2
December	3,915.9	2,428.9	6,989.7
1957—			
January	3,986.1	2,645.7	7,290.5

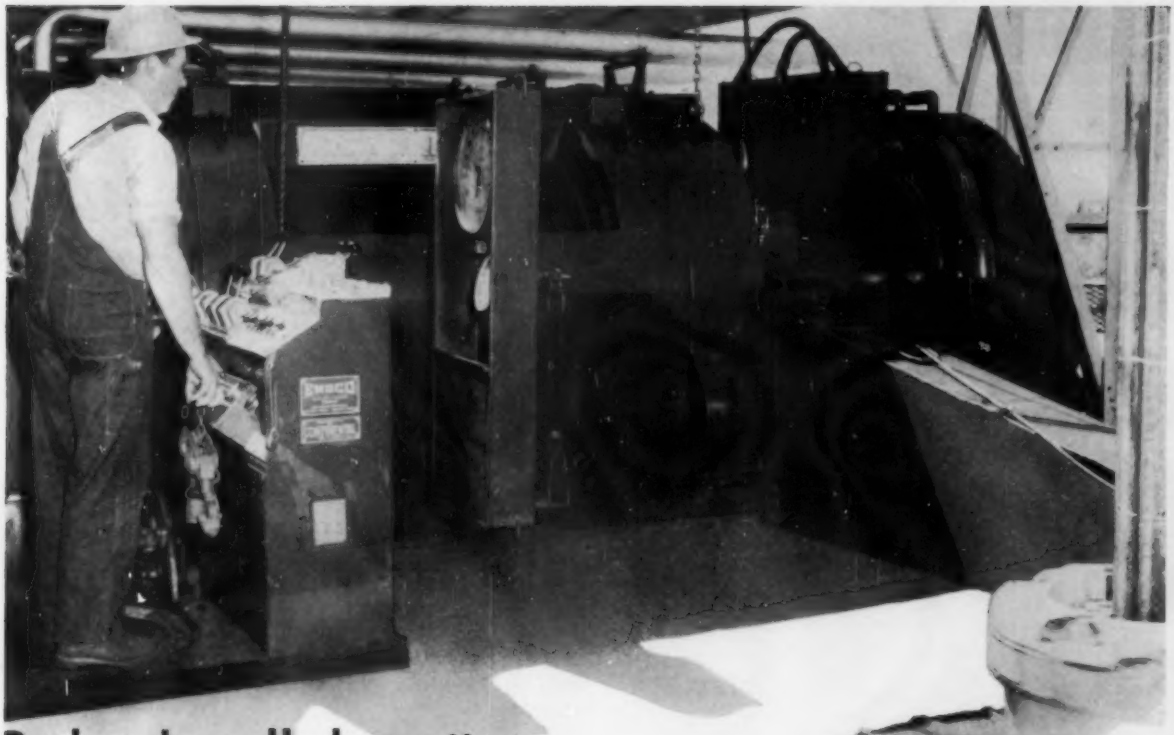
World-Wide Crude-Oil Production

(Daily average in thousands of barrels)

Country—	Jan. 1957	Dec. 1956	Jan. 1956
W. Hemisphere:			
Argentina	93.0	93.0	84.5
Bolivia	9.2	9.2	8.0
Brazil	24.7	24.7	7.0
Canada	534.0	536.2	438.8
Chile	10.6	10.6	7.4
Colombia	122.1	122.1	116.1
Cuba	1.5	1.1	1.5
Ecuador	9.7	9.7	8.9
Mexico	250.0	250.0	242.0
Peru	53.7	53.7	47.7
Trinidad	85.6	84.0	73.3
Venezuela	2,792.0	2,721.6	2,324.5
Total	3,986.1	3,915.9	3,359.7
W. Europe & Africa:			
Algeria	0.4	0.4	0.9
Fr. Morocco	1.8	1.8	2.1
Egypt	0	0	35.7
Austria	64.6	64.6	65.4
France	28.9	29.3	20.5
West Germany	71.0	71.3	63.9
Italy	20.5	18.2	7.4
Netherlands	25.8	24.6	19.2
Turkey	6.5	6.5	4.8
United Kingdom	1.6	1.2	1.1
Yugoslavia	6.9	6.4	5.2
Total	228.0	224.3	226.2
Middle East:			
Bahrain	30.1	30.1	30.0
Iran*	657.0	524.0	364.0
Iraq†	226.8	220.9	715.1
Israel	1.1	1.1	0.3
Kuwait	910.0	820.0	1,124.8
Neutral Zone	30.0	25.0	26.1
Qatar	125.5	117.5	121.2
Saudi Arabia	665.2	690.3	1,000.3
Total	2,645.7	2,428.9	3,381.8
Other Asia:			
British Borneo	118.0	118.0	115.3
Burma	4.5	4.5	4.7
India	9.2	9.2	7.5
Indonesia	280.0	270.0	235.5
Japan	6.0	5.9	6.4
New Guinea	7.1	7.1	7.8
Pakistan	5.9	5.9	5.8
Total	430.7	420.6	383.0
Free World:			
Foreign	7,290.5	6,989.7	7,350.7
United States	7,480.0	7,377.0	7,199.0
Total Free W.	14,770.5	14,366.7	14,549.7
Communist countries in Soviet orbit:			
Romania	220.0	220.0	200.0
Russia‡	1,810.0	1,785.0	1,550.0
Others	50.0	50.0	50.0
Total	2,080.0	2,055.0	1,800.0
World total	16,850.5	16,421.7	16,349.7

*Includes estimated 4,000 bbl. daily from Naft-i-Shah field not operated by consortium companies. †Includes estimated 5,000 bbl. daily from Naft Khaneh field, operated by British Petroleum Co. ‡Revised estimate.

Figures are from reliable industry reports or official government sources. Data for Communist countries in the Soviet orbit, which includes the European satellites and Red China, are based on competent estimates. Authentic information is not available on month-to-month production in these areas. Estimates also were made for those countries, particularly in Southeast Asia, where complete current reports are lacking.



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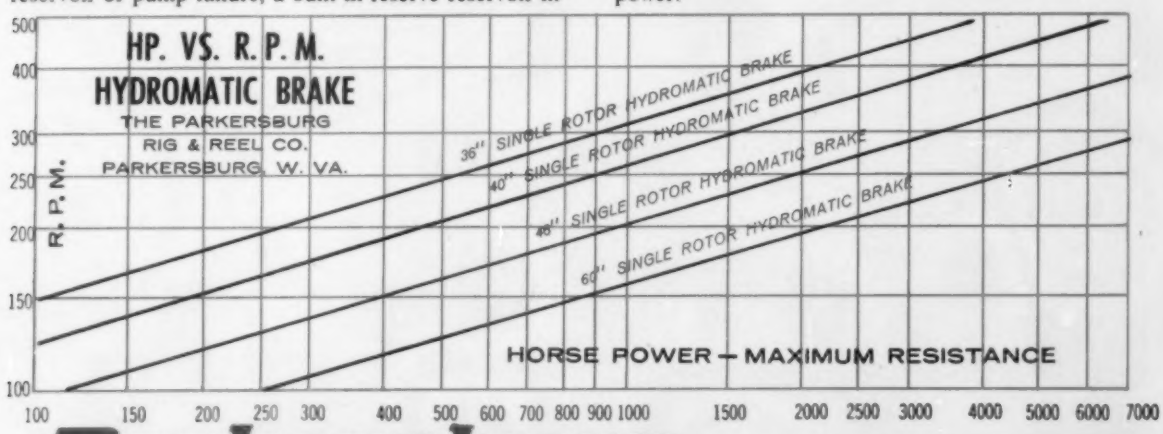

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Sumatra Blossoms Out

● Caltex will spend millions to develop central area where Minas field is booming, two others are promising

IT has been more than 30 years since the first geologists for what is now the Caltex group of companies began nosing through the swampy jungles of Central Sumatra. A full 15 years passed after that before the first oil of any significance was found.

The third and most promising discovery was only a gleam in a geologist's eye when the Japanese invaded Sumatra and the rest of the chain of islands that is now Indonesia. Caltex had moved a rig onto a structure at Minas, about 50 miles north of the equator in the east-central part of Sumatra when the Japanese came. Company personnel were evacuated, but the rig was left.

Using that rig, the Japanese put down a hole and discovered Minas field. It was not until 1949 that Caltex was able to return to the area and do what they started years before—develop the Minas structure. Since then the field has been quietly, but consistently spreading. The annual increases in production tell the story: 1954, about 41,000 bbl. daily; 1955, about 55,000 bbl. daily; last year, about 88,000 bbl. daily. Today Minas is producing about 125,000 bbl. daily.

Last week, just as quietly as it has developed the field, Caltex took the wraps off a major program for this area of Central Sumatra (see map). The plan involves spending millions in the face of a very unsettled political picture and a whole series of bloodless revolts in Indonesia.

Here's what is involved:

. . . **Full-scale development of two more fields** in addition to Minas.

. . . **A 30-in. pipeline** more than 30 miles long to link the new fields with a new deep-water loading port.

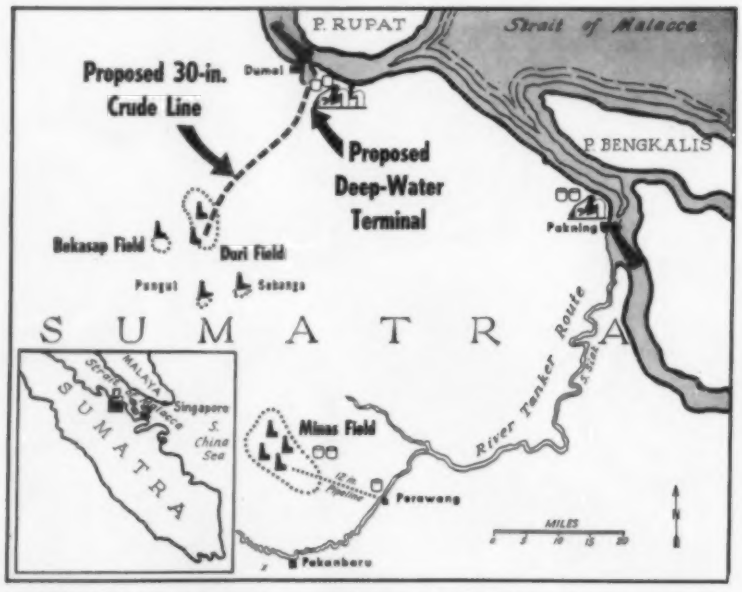
. . . **A complete new terminal at Dumai** that will accommodate the biggest tankers available to haul Sumatra crude.

. . . **A two-lane roadway** flanking the 30-in. pipeline to provide the first overland route for vehicular traffic between Sumatra's east and west coasts.

. . . **Eventual linking of Minas** field with the pipeline, making it possible to move Minas crude directly to the deep-water terminal.

It's an ambitious program for an equatorial area that consists almost entirely of swamps and jungle. How much it will cost is one of those questions Caltex prefers to minimize.

The company calls it a "multimillion dollar" expansion program. Except for the pipeline link between Minas and Duri field, where the 30-in. will end, the project will be completed by early 1959. The line to add Minas to the system will come later.



WHERE CALTEX is planning its multimillion-dollar development push in Sumatra.

The fields . . . Caltex actually has four oil fields in the area in addition to Minas. The program outlined above calls for the development of only two of them.

One of the two, Duri, was discovered in 1940, long before the Minas development. The other, Bekasap, is the area's most recent discovery.

The shallow, 800-ft. Miocene sandstone reservoir at Duri was found by Caltex a short time after the company's first discovery at Sebanga in 1940. By the time the war started, three wells had been completed in the 1,200-ft. Sebanga reservoir and one gas and four oil wells were completed at Duri.

The shallow Duri field only produced about 53,000 bbl. of its 22°-gravity crude between 1940 and 1956, but things are moving ahead. Two rigs are now running in the field and 19 wells have been completed. Drilling in Duri is tricky, to say the least. The shallow pay is deceptive. Moving in, rigging up, and getting out after completion poses many problems. Most of the field lies under 2 to 6 ft. of water in a swampy region where solid ground is a rarity.

The Bekasap test in 1955 found a deeper, 3,000-ft. pay and a much lighter 35°-gravity crude. No immediate drilling is in prospect for Bekasap, at least not in the initial stages of the Caltex program, but a 14-in. pipeline will link it with Duri.

The fourth field, Pungut, to the west of Sebanga and south of Bekasap, discovered 39°-gravity oil at about 2,940 ft. in 1951. Production from this field amounted to only a little more than 12,000 bbl. up to 1956. It is being used locally.

At Minas, Caltex now has 158 wells producing about 125,000 bbl. daily from the Telisa, a Miocene sand reservoir that averages about 2,500 ft. in depth. The structure is a fold with an axis parallel to the general northwest-southeast trend of the island.

The company is completing about 16 wells a year in Minas in its steady development program which will be continued.

Moving Minas crude now . . . Getting the production from Minas to deep-water facilities for big-tanker lifting is a complicated and rather laborious job. The oil is moved through a 12-in. line from the field to a tank farm and terminal on the Siak River at Perawang, about 19 miles downriver from the company's main camp at Rumbai.

At Perawang it is loaded by river tankers for the 93-mile downriver run to Pakning, the port for ocean-going

tankers. Caltex has four 24,000-bbl. tankers and two 27,000-bbl. tankers in this shuttle service on the river. On a 24-hour basis, these tankers make about 125 trips a month.

Once Minas field is linked to the 30-in. Duri-Bekasap pipeline now planned, the entire crude flow will be reversed and these river tankers will no longer be needed.

The new terminal . . . Dumai is a little fishing village on the Rupat Strait, a waterway into the big Malacca Strait. Caltex plans to change its entire complexion.

The company will clear land and build housing and storage necessary to support a major deep-water loading port. The piers and docks at Dumai will handle the largest seagoing tankers afloat or planned.

Dumai will probably emerge from it all as a bustling port. The roadway which will parallel the pipeline into Dumai will not only let Caltex patrol the line easily, but it will also link with roads in the interior and give Sumatra a network of roads with commercial possibilities.

The jungle, swamp, and the Japanese have conspired to make the progress slow in Central Sumatra. But Caltex indicates that things are now opening up on a large scale.

Site Picked for Refinery

The intersection of the Rhine and Ruhr rivers is the site of a 20,000-bbl. refinery to be built by a West German subsidiary of Cie. Financiere Belge des Petroles S.A. (Petrofina).

Plans for the refinery, which will eventually be expanded to 60,000 bbl. daily, were revealed several months ago but the site had not been selected *(The Oil and Gas Journal, October 22, 1956, page 84).*

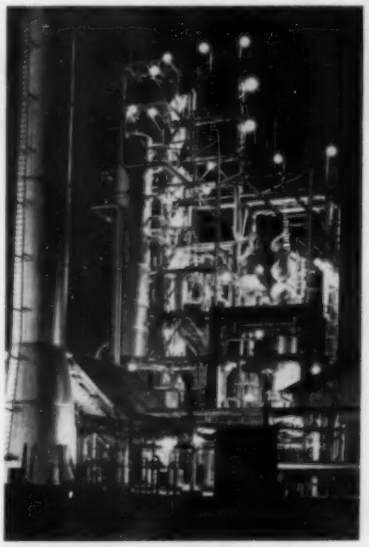
Plans for the new refinery will have no effect on the 6,500-bbl. refinery operated by Ruhrbau Mineraloelraffinerie G.m.b.H., at Muehlheim near Cologne. Petrofina bought a 75 per cent interest in this plant last year. Output of both refineries will be marketed by Deutsche Purfina G.m.b.H., Frankfort.

B.P. Folds Iranian Company

The lingering shadow of the Iranian nationalization dispute hung briefly over London recently as Kermanshah Petroleum Co. quietly went out of business.

The small subsidiary of British Petroleum Co., Ltd., had been a company without portfolio since National Iranian Oil Co. took over its operations in 1951.

Kermanshah Petroleum operated the 10,000-bbl. daily Naft-i-Shah field and transported crude to its Kermanshah refinery through a 145-mile, 3-in. pipeline. The products were marketed in western Iran. The company was organized in 1934.



Burmese Refinery Rises from Ashes Of War-Torn Plant

LIKE the fabled phoenix, the Syriam refinery near Rangoon has risen from its own ashes.

This 3,500-bbl. daily crude distillation unit was dedicated last week by U Ba Swe, deputy premier of Burma, on the site once occupied by the old 21,000-bbl. daily Syriam refinery. The old plant was destroyed by the British in their retreat from Burma in World War II. The new one was built by Foster Wheeler, Ltd., under contract with Burma Oil Co. (1954), Ltd., one-third owned by the government and two-thirds by the old established British companies headed by Burmah Oil Co., Ltd.

The new crude unit at Syriam, plus the 3,000-bbl. daily plant at Chauk, will make Burma self sufficient in major petroleum products.

Crude to supply the new refinery is moved 300 miles down the Irrawaddy River by pusher barge trains from the Chauk field. The barge trains have been moving crude downriver for months building up 135,000 bbl. of storage before the plant went on stream. With the unit in operation only about 4,000 bbl. daily will be moved to keep storage at a constant level.

Petrosud Busy Again

Partner takes over in wake of Gulf retreat from Italy

GULF OIL CORP.'S former partner in Italian exploration has taken up where the partnership left off.

Montecatini Sta. Generale per l'Industria Chimica e Moneraria has started redrilling 6 Cigno. This well was near completion in January when Gulf's subsidiary made good its warning that the new oil law for Italian mainland was too tough and pulled out *(The Oil and Gas Journal, January 28, page 137).*

Montecatini at that time acquired sole ownership of the operating company, Petrosud, S.A. This included exploration licenses on 456,798 acres, and drilling and other equipment.

Cigno field, located near the Adriatic Coast east of Rome, was discovered in 1955. The discovery well initially tested 2,000 bbl. daily from 2,300 ft.

Except for test-production permits, the Italian Government never permitted the field to produce. The 1 and 2 wells were shut in last year because of water encroachment.

Montecatini currently has two rigs in Cigno field, and it plans to make seismic surveys on its Marche license, which adjoins the Cigno area to the north. It made a new application for a production permit on January 31. The government has not yet given its decision.

Six-Rig Company Sold

Falcon Seaboard Drilling Co. of Tulsa will take its first step into foreign operations as a drilling contractor this week.

The company is buying Drosdat & Dotson Drilling & Construction Co., S.A., for $2,213,757. A wholly owned subsidiary, the Venezuelan Co., has been formed to make the purchase and carry out Venezuelan operations.

Last week, Falcon put 300,000 shares of its common stock on the market, partly to finance the deal which gives Falcon six rigs, three drilling and three workover, and more than 20 rig haulers *(The Oil and Gas Journal, December 17, 1956, page 98).* Purchase should be completed April 4.

Falcon Seaboard's only foreign holding at present is 7 per cent interest in Bolivian Gulf Oil Co. Falcon owns about 1,500 bbl. daily of production and operates 27 rigs in the U. S.

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OIL FINDING

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- A look at active areas in 1957
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- The 1956 scoreboard on wildcats
- Abstracts of A.A.P.G. Papers

EXPLORATORY DRILLING'S SUCCESS RATIO fell from 20.79 in 1955 to 19.79 in 1956. Fig. 1.

WILDCAT SCOREBOARD for '56...

- **16,173 exploratory wells . . . up 1,236 over '55**
- **84 per cent located on technical advice**
- **One in nine finds a new field**
- **One in 44 finds million-barrel reserve**

by Graham B. Moody

This abridgment of the report of the chairman of the American Association of Petroleum Geologists' Committee on Exploratory Statistics, presented at the association's annual meeting in St. Louis, April 1-4, is published by special permission of the author and the A.A.P.G. The full report will be published in the June bulletin of A.A.P.G.

8,709 new-field wildcats, 3,841 new-pool tests, 3,623 outposts

IN the last 13 years in the United States new-field wildcats have comprised approximately 55 per cent of the total number of exploratory holes. Of these new-field wildcats, during the last 13 years, the percentage located on technical advice has risen from 77 per cent to 84 per cent. In this same period nearly three times as many new-field wildcats have been successful when located on technical advice as those not so located. Taking all new-field wildcats into consideration there has been an almost constant success-to-failure ratio. The average for the 13 years has been 11.70 per cent, with a range from a low of 10.65 per cent to a high of 12.22 per cent. That is, one hole in every nine has found some oil or gas.

But even more significant than these figures has been our study of the total ultimate reserves of oil discovered by these new-field wildcats. Briefly, this study, which is based on fields having a minimum of 6 years of development history, shows that only 1 new-field wildcat out of every 44 drilled discovers a field with as much as 1 million barrels of estimated total ultimate reserves. Nearly 98 per cent of all new-field wildcats drilled are failures in that they are abandoned as dry or they discover reserves too small, on the average, to be profitable.

During 1956, 16,173 exploratory holes were drilled in the United States. Of these 8,709 were new-field wildcats, 3,841 were new-pool tests (including new-pool wildcats, deeper-pool tests, and shallower-pool tests), and 3,623 were outposts. Among the new-field wildcats, 868 were successful among the new-pool tests 1,021 were successful; and among the outposts 1,207 were successful.

The total exploratory footage drilled in the United States in 1956 was 73,981,176 ft. in the 16,173 holes, or 4,574 ft. per hole. These figures compare with 69,173,209 ft. drilled in 14,937 exploratory holes, with an average depth of 4,631 ft. in 1955.

Our committee has continued to use the classification of exploratory holes as outlined in Table 1. The same classification is used in Canada and Mexico. All holes are grouped according to their preliminary classification (I in Table 1) whether or not their original objective is attained. Under this classification (I), the holes are then grouped according to their completion classification (II in Table 1). It is to be noted that, while a majority of outposts, or, as we may also call them, "extension tests," if successful, are completed as extension wells, some discover new pools and therefore are completed as new-pool discovery wells. Similarly, any type of new-pool test, if successful, may be completed as an extension well rather than as a new-pool discovery well. These possibilities are indicated in parenthesis under Columns B, 2a, 2b, and 2c, in Table 1.

During 1956, a total of 73,981,176 ft. was drilled in 16,173 exploratory holes, divided as follows:

	Feet
3,096 producers	16,284,871
13,077 dry holes	57,696,305

This means that 19.79 per cent of the holes drilled, and 22.01 per cent of the footage drilled, were successful in 1956. One producer foot was drilled for every 3.55 ft. of dry hole. One successful well was drilled for every 4.05 dry holes. The average depth of hole was 4,574 ft.

Attention is called to the average depth figures for the various producing classes and for dry holes, and totals, at the bottom of the footage columns in Table 2.

Reserves for drilling . . . In Table 3 are listed the reasons for drilling the new-field wildcats in 1956, by using the best information available from men familiar with such statistics, each in his own state or district. According to these figures 795 new-field wildcats drilled on technical advice (geology or geophysics or both) were successful, and 6,488 were dry; 25 holes, located for nontechnical reasons, were producers, and 463 were dry; 48 producers and 890 dry holes were located for reasons unknown. These figures show that 10.9 per cent of the new-field wildcats drilled in technical advice were producers as contrasted with 5.2 per cent successful in the case of holes located without technical advice. Therefore, in 1956, locations for new-field wildcats based on technical recommendations were 2.1 times as successful as those drilled without such advice. Seismographic methods were involved in locating 334 producers and 1,906 dry holes among the new-field wildcats.

Table 4 shows the relative success, as measured by the number of pro-

TABLE I. CLASSIFICATION OF EXPLORATORY WELLS

				I. *Classification When Drilling Is Started*	II. *Classification after Completion or Abandonment*	
					Successful	*Unsuccessful*
				A	*B*	*C*
Drilling for long extension of partly developed pool				1 Outpost (Extension test)	1 Extension well (Sometimes a new-pool discovery well)	1 Dry outpost (Dry extension test)
Drilling for a *new pool* on a structure or in a geological environment already productive	New-pool tests	Drilling within limits of proved area of pool	For new pool *above* deepest pool	2a Shallower-pool test	2a Shallower-pool discovery well (Sometimes shallower-pool extension well)	2a Dry shallower-pool test
			For new pool *below* deepest pool	2b Deeper-pool test	2b Deeper-pool discovery well (Sometimes deeper-pool extension)	2b Dry deeper-pool test
		Drilling outside limits of proved area of pool		2c New-pool wildcat	2c New-pool discovery wildcat (Sometimes an extension well)	2c Dry new-pool wildcat
					New-pool discovery wells (Or, in places, extension wells)	Dry new-pool tests
Drilling for a *new field* (on a structure or in an environment never before productive)				3 New-field wildcat	3 New-field discovery wildcat	3 Dry new-field wildcat

THE AUTHOR

Graham B. Moody, Berkeley, Calif., consulting geologist, is president-elect of the American Association of Petroleum Geologists. Moody joined Standard Oil Co. of California in 1920, retiring recently. He has served in field assignments over a wide area of the United States, and in Mexico and the Philippines. Active in professional circles of the industry, Moody is affiliated with the A.P.I., Seismological Society of America, and Petroleum Production Pioneers. He was chief reserves engineer, executive staff, for Standard.

WILDCAT SCOREBOARD

TABLE 2—NUMBER OF OIL WELLS, GAS WELLS, CONDENSATE WELLS, AND DRY HOLES DRILLED IN UNITED STATES AS EXPLORATORY TESTS IN 1956

States—	Oil producers		Gas producers		Condensate producers		Total producers		Dry holes		Grand total		Avg. hole depth*
	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	No. of holes	Footage	
Alabama	1	10,934	0	0	0	0	1	10,934	28	143,555	29	154,489	5,327
Arizona	0	0	1	5,900	1	5,648	2	11,548	2	4,753	4	16,301	....
Arkansas	48	159,377	9	44,419	0	0	57	203,796	201	720,430	258	924,226	3,582
California	87	530,332	25	107,809	0	0	112	638,141	490	2,395,803	602	3,033,944	4,040
Colorado	39	233,550	33	159,150	0	0	72	392,700	668	3,308,101	740	3,700,801	5,001
Florida	0	0	0	0	0	0	0	0	13	90,729	13	90,729	....
Georgia	0	0	0	0	0	0	0	0	9	30,393	9	30,393	....
Idaho	0	0	0	0	0	0	0	0	5	19,534	5	19,534	....
Illinois	84	200,138	11	7,565	0	0	95	207,703	1,007	2,072,817	1,102	2,280,520	2,069
Indiana	36	66,092	1	1,630	0	0	37	67,722	264	425,006	301	492,728	1,637
Kansas	378	1,258,348	99	413,250	0	0	477	1,671,598	1,430	5,255,055	1,907	6,926,653	3,632
Kentucky	72	82,272	10	21,264	0	0	82	103,536	434	573,020	516	676,556	1,311
Louisiana	146	1,356,758	42	418,661	103	1,219,876	291	2,995,295	748	7,125,301	1,039	10,120,596	9,741
Michigan	13	34,764	1	1,129	0	0	14	35,893	152	429,888	166	465,781	2,806
Mississippi	16	105,150	0	0	4	27,821	20	132,971	199	1,539,421	219	1,672,392	7,636
Missouri	0	0	1	450	0	0	1	450	5	9,001	6	9,451	....
Montana	13	95,266	2	5,580	0	0	15	100,846	198	897,014	213	997,860	4,685
Nebraska	49	281,938	1	5,733	0	0	50	287,671	453	2,448,335	503	2,736,006	5,439
Nevada	0	0	0	0	0	0	0	0	6	36,833	6	36,833	....
New Mexico	83	496,549	26	122,732	8	60,819	117	680,100	260	1,225,930	377	1,906,030	5,056
New York	0	0	3	10,548	0	0	3	10,548	19	75,448	22	85,996	....
North Dakota	15	122,206	0	0	0	0	15	122,206	85	458,589	100	580,795	5,808
Ohio	11	33,934	21	61,075	0	0	32	95,009	46	93,536	78	188,545	2,417
Oklahoma	185	839,494	64	326,679	17	120,123	266	1,286,296	863	3,541,653	1,129	4,827,949	4,276
Oregon	0	0	0	0	0	0	0	0	1	12,880	1	12,880	....
Pennsylvania	0	0	8	53,858	0	0	8	53,858	19	87,734	27	141,592	5,244
South Dakota	0	0	0	0	0	0	0	0	45	86,532	45	86,532	1,923
Tennessee	1	565	0	0	0	0	1	565	21	33,847	22	34,412	....
Texas	956	4,966,490	156	836,625	116	887,742	1,228	6,720,857	5,012	22,828,958	6,240	29,549,815	4,736
Utah	22	127,946	7	39,159	0	0	29	167,105	66	278,912	95	446,017	4,695
Washington	0	0	0	0	0	0	0	0	5	32,338	5	32,338	....
West Virginia	2	5,200	35	114,758	0	0	37	119,958	20	76,337	57	196,295	3,444
Wyoming	17	66,250	16	96,697	1	4,618	34	167,565	303	1,338,622	337	1,506,187	4,469
Total U. S.	2,274	11,103,553	572	2,854,671	250	2,326,647	3,096	16,284,871	13,077	57,696,305	16,173	73,981,176	4,574

*Average per well footage given only where 25 or more wells were drilled in the state.

ducers in comparison with the number of dry holes, in each year from 1944 to 1956, inclusive.

As indicated in Table 1, a hole may be located as an outpost with the intention of trying to extend a pool partly developed, but instead it may discover a new pool; and, similarly, a new-pool wildcat may be located in search of a new pool because it is believed to be well outside the limits of the known pool, but instead it may result in extending this known pool farther than had been expected. A majority of outposts, if successful, are completed as extension wells and a majority of new-pool wildcats, if successful, discover new pools. Here we see that 1,068 outposts were completed as extension wells and 139 were completed as new-pool discoveries; and 535 new-pool wildcats discovered new pools whereas 173 new-pool wildcats were completed as extension wells.*

*The new-pool discoveries referred to are all the result of exploratory drilling. In addition to these, at least 185 new pools were discovered in the drilling of field-development wells. These included 126 discoveries of oil, 28 or gas, and 31 of condensate.

Some years ago we included in our annual report a table showing the number of fields discovered each year, from 1938 to the year preceding the year reported, these fields being grouped according to a rough estimate of their total ultimate reserves from the date of discovery. The fields were grouped according to these estimates: "A" meaning a total ultimate of 50 million barrels or more; "B," from 25 to 50 million barrels; "C," from 10 to 25 million barrels; "D," from 1 to 10 million barrels; "E," less than 1 million barrels; and "F," abandoned. Gas fields were not included unless they also produced oil or condensate. A few fields were omitted where satisfactory estimates were not readily obtainable. This lengthy tabulation has been discontinued but new-field discoveries in 1956 are classified as follows: 1 A, 14 C's, 83 D's, 662 E's, 10 F's, 98 gas.

In the present report we are repeating the approach followed in 1955. In other words, we are recording, in Table 5, estimated total ultimate reserves for only the discoveries of 1950 and 1953. Where necessary, revisions have been made of the earlier estimates of these fields discovered in those years.

In revising these earlier estimates for discoveries of 1950, as made 3 years ago, 2 A's remained unchanged; 4 B's were raised to A; 1 A was lowered to B; 5 B's remained unchanged; 3 C's were raised to B; 12 C's remained unchanged; 3 D's and 2 E's were raised to C; 2 C's were lowered to D; 65 D's remained unchanged; 1 D was raised to B; 22 E's were raised to D; 8 D's were lowered to E; 246 E's remained unchanged; 1 F was revived as an E, and 1 was revived as a D; 33 E's became F's; 4 E's were consolidated with other fields, hence, not discoveries; 66 F's remained unchanged. Fifty-nine gas fields remained gas fields; three became E's, one became F.

In revising the January 1, 1953, estimates of 1952 discoveries: 1 A remained unchanged; 1 B was raised to A; 3 B's were lowered to C; 8 C's remained unchanged; 1 C was raised to A; 2 C's were raised to B; 4 C's were lowered to D; 1 C was lowered to E; 52 D's remained unchanged; 3 D's were raised to B; 4 D's were raised to C; 14 D's were

TABLE 3—BASIS FOR LOCATING NEW-FIELD WILDCATS DRILLED IN 1956

State—	Geology		Geophysics		Geology and geophysics		Sundry nontechnical		Unknown		Total		Grand total
	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	Producers	Dry holes	
Alabama	0	17	0	6	0	4	0	0	0	0	0	27	27
Arizona	0	1	1	0	1	0	0	0	0	1	2	2	4
Arkansas	10	61	0	2	0	34	0	0	0	16	10	113	123
California	5	112	1	8	0	39	0	35	0	3	6	197	203
Colorado	25	252	5	75	13	79	0	82	0	53	43	541	584
Florida	0	8	0	2	0	2	0	1	0	0	0	13	13
Georgia	0	5	0	3	0	0	0	1	0	0	0	9	9
Idaho	0	3	0	0	0	0	0	2	0	0	0	5	5
Illinois	16	420	0	0	1	12	0	7	0	0	17	439	456
Indiana	8	181	0	0	0	0	0	0	0	0	8	181	189
Kansas	9	94	8	40	1	5	0	0	6	119	24	258	282
Kentucky	2	0	0	0	0	0	0	0	0	1	2	1	3
Louisiana	15	197	40	93	32	186	0	3	0	0	87	479	566
Michigan	4	109	0	4	0	2	0	0	1	3	5	118	123
Mississippi	13	145	2	16	1	28	0	0	0	5	16	194	210
Missouri	0	0	0	0	0	0	0	0	1	3	1	3	4
Montana	1	83	5	58	1	33	0	8	0	0	7	182	189
Nebraska	25	103	6	51	3	11	5	193	0	38	39	396	435
Nevada	0	0	0	1	0	1	0	2	0	0	0	4	4
New Mexico	40	120	3	15	11	29	0	24	0	5	54	193	247
New York	0	9	0	0	0	0	0	2	0	0	0	11	11
North Dakota	1	16	0	0	4	64	0	2	0	0	5	82	87
Ohio	0	6	0	0	0	0	0	0	0	0	0	6	6
Oklahoma	32	200	14	47	25	146	0	0	3	3	74	396	470
Oregon	0	1	0	0	0	0	0	0	0	0	0	1	1
Pennsylvania	0	5	0	0	1	0	0	0	1	7	2	12	14
South Dakota	0	30	0	2	0	6	0	4	0	3	0	45	45
Tennessee	0	15	0	0	0	0	0	0	0	6	0	21	21
Texas	246	2,176	56	216	89	494	17	74	36	624	444	3,584	4,028
Utah	3	41	4	9	0	3	0	6	0	0	7	59	66
Washington	0	3	0	1	0	0	0	1	0	0	0	5	5
West Virginia	2	4	0	0	0	1	2	2	0	0	4	7	11
Wyoming	4	165	2	9	4	69	1	14	0	0	11	257	268
Total	461	4,582	147	658	187	1,248	25	463	48	890	868	7,841	8,709

lowered to E; 365 E's remained unchanged; 1 E was raised to B; 6 E's were raised to C; 45 E's were raised to D; 1 E became a gas field; 9 F's remained unchanged; 1 F was revived as an E; 70 gas fields remained unchanged; 3 gas fields became E; 1 D, 66 E's and 3 gas fields were lowered to F; 4 D's, 47 E's and 3 gas fields were consolidated with other fields, hence, no discovery.

Exploratory Drilling in Canada

In western Canada, in 1956, 904 exploratory holes were completed, 288 of these being producers and 616 being dry holes. The producers included 189 oil wells and 99 gas wells. A total of 4,363,494 ft. was drilled, 1,528,392 ft. in producers, and 2,835,102 ft. in dry holes (Table 6). This means that 25.22 per cent of the exploratory holes and 35.03 per cent of the exploratory footage were successful. There were 1.85 ft. drilled in dry holes for every foot drilled in producers. For every producer completed 3.26 dry holes were abandoned. The average depth of all the exploratory holes was 4,827 ft.

Among the 588 new-field wildcats completed in western Canada in 1956 108 were successful and 480 were dry. In other words, new-field wildcatting

TABLE 4—RELATIVE SUCCESS OF EXPLORATORY DRILLING IN UNITED STATES FROM 1944 TO 1956, INCLUSIVE

Year	New-field wildcats		All exploratory holes	
	Number of dry holes for each producer	Percentage of wells successful	Number of dry holes for each producer	Percentage of wells successful
1944	8.05	11.05	4.08	19.67
1945	7.63	11.59	3.62	21.64
1946	8.39	10.65	4.06	19.76
1947	7.80	11.32	3.90	20.34
1948	7.57	11.66	4.50	18.25
1949	7.79	11.37	3.95	20.20
1950	7.93	11.19	4.11	19.54
1951	8.05	11.05	4.30	18.86
1952	8.05	11.06	4.32	18.78
1953	7.95	11.18	3.98	20.13
1954	7.18	12.22	3.83	20.68
1955	7.82	11.32	3.81	20.78
1956	9.03	9.97	4.22	19.13
1944-1956, inclusive	7.95	11.17	4.05	19.79

TABLE 5—FIELDS* DISCOVERED IN 1950 AND 1953 GROUPED ACCORDING TO THEIR TOTAL ULTIMATE RESERVES AS ESTIMATED JANUARY 1, 1957

Year	Number of fields discovered in year indicated by reserves groups†						Total A – F inclusive	A + B + C fields	Percentage of A + B + C fields in total fields
	A	B	C	D	E	F			
1950	6	10	17	92	257	103	485	33	6.80
1953	5	7	21	101	390	109	633	33	5.21

*This table refers only to the states of Alabama, Arkansas, California, Colorado, Illinois, Indiana, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Montana, Nebraska, New Mexico, Oklahoma, Texas, and Wyoming. It does not include gas fields unless natural-gas liquids are produced, and then the reserves figure relates only to these liquids. A few fields were omitted because of inadequate estimates, and a few producing areas, at first thought to be new fields, have become consolidated with other fields.

†In this table, A means 50 million barrels or more, B means between 25 and 50 million barrels, C means between 10 and 25 million barrels, D means between 1 and 10 million barrels, E means less than 1 million barrels, F means abandoned.

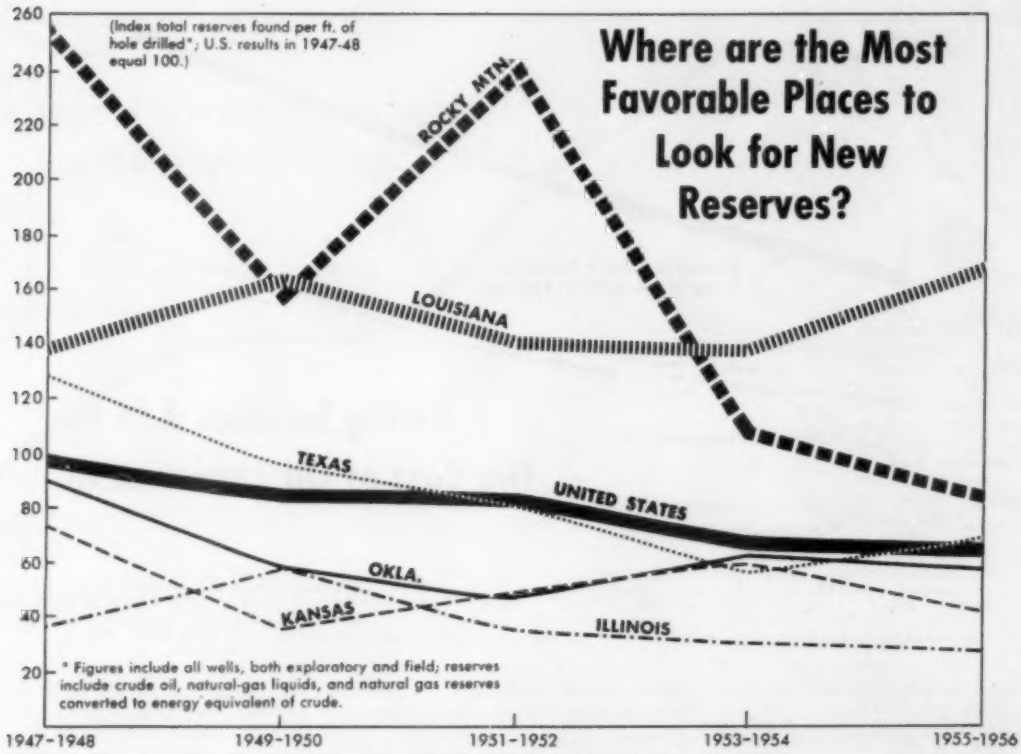
was 18.37 per cent successful. One producer was drilled for every 4.44 dry holes.

In eastern Canada, 149 exploratory holes were drilled, with a total of 258,822 ft. Fifteen of the 149 holes were successful, 10 as gas wells, and 5 as oil wells. In these producers, 16,342 ft. was drilled. Of the 149 holes, 10.07 per cent were successful; 6.31 per cent of the exploratory footage was in successful holes. For every foot drilled in producers, 14.84 ft. was drilled in dry holes. The average depth of hole was 1,737 ft. **End.**

TABLE 6—EXPLORATORY DRILLING IN CANADA IN 1956

Province and well classification—	Oil		Gas		Total producers		Dry holes		Grand total	
	No.	Footage	No.	Footage	No.	Footage	No.	Footage	No.	Footage
Alberta:										
Outposts	54	322,264	19	91,749	73	414,013	33	166,030	106	580,043
New-pool wildcats	12	62,285	14	76,598	26	138,883	26	114,829	52	253,712
Deeper-pool tests	0	0	3	5,427	3	5,427	18	25,536	21	30,963
Shallower-pool tests	2	10,604	3	10,512	5	21,116	0	0	5	21,116
New-field Wildcats	27	248,630	43	183,853	70	432,483	234	1,297,826	304	1,730,309
Total	95	643,782	82	368,139	177	1,011,922	311	1,604,221	488	2,616,143
British Columbia:										
Outposts	0	0	0	0	0	0	3	14,688	3	14,688
Deeper-pool tests	0	0	*1	297	1	297	1	705	2	1,002
New-field Wildcats	0	0	11	84,147	11	84,147	12	77,423	23	161,570
Total	0	0	12	84,444	12	84,444	16	92,816	28	177,260
Manitoba:										
Outposts	3	6,369	0	0	3	6,369	0	0	3	6,369
New-field Wildcats	1	3,150	0	0	1	3,150	40	113,949	41	117,099
Total	4	9,519	0	0	4	9,519	40	113,949	44	123,468
Northwest Territories:										
New-field Wildcats	0	0	0	0	0	0	3	6,038	3	6,038
Total	0	0	0	0	0	0	3	6,038	3	6,038
Saskatchewan:										
Outposts	41	184,043	1	3,134	42	187,177	24	94,679	66	281,856
New-pool wildcats	25	113,758	1	3,220	26	116,978	28	123,504	54	240,482
Deeper-pool tests	1	158	0	0	1	158	3	7,539	4	7,697
New-field Wildcats	23	108,872	3	9,322	26	118,194	191	792,356	217	910,550
Total	90	406,831	5	15,676	95	422,507	246	1,012,426	338	1,434,934
Total Western Canada:										
Outposts	98	512,676	20	94,883	118	607,559	60	275,397	178	882,956
New-pool wildcats	37	176,043	15	79,818	52	255,861	54	238,333	106	494,194
Deeper-pool tests	1	158	5	5,724	5	5,882	22	33,780	27	39,662
Shallower-pool tests	2	10,604	3	10,512	5	21,116	0	0	5	21,116
New-field Wildcats	51	360,652	57	277,322	108	637,974	480	2,287,592	588	2,925,566
Total	189	1,060,133	99	468,259	288	1,528,392	616	2,835,102	904	4,363,494
Newfoundland:										
New-field Wildcats	0	0	0	0	0	0	2	5,176	2	5,176
Total	0	0	0	0	0	0	2	5,176	2	5,176
Ontario:										
Outposts	3	1,323	5	5,065	8	6,388	13	13,788	21	20,176
New-pool wildcats	1	316	2	3,756	3	4,072	35	57,720	38	61,792
Deeper-pool tests	0	0	0	0	0	0	1	993	1	993
New-field Wildcats	1	341	2	4,306	3	4,647	71	133,293	74	137,940
Total	5	1,980	9	13,127	14	15,107	120	205,794	134	220,901
Quebec:										
New-field Wildcats	0	0	1	1,235	1	1,235	12	31,510	13	32,745
Total	0	0	1	1,235	1	1,235	12	31,510	13	32,745
Total Eastern Canada:										
Outposts	3	1,323	5	5,065	8	6,388	13	13,788	21	20,176
New-pool wildcats	1	316	2	3,756	3	4,072	35	57,720	38	61,792
Deeper-pool tests	0	0	0	0	0	0	1	993	1	993
New-field Wildcats	1	341	3	5,541	4	5,882	85	169,979	89	175,861
Total	5	1,980	10	14,362	15	16,342	134	242,480	149	258,822
Total Canada, all classes	194	1,062,113	109	482,621	303	1,544,734	750	3,077,582	1,053	4,622,316

*Gas. †Condensate.



DRILLING RESULTS pay off best in Louisiana, particularly in South Louisiana and offshore. Next come the Rocky Mountains. These are the only two key areas studied that consistently beat the national averages in finding new reserves. Fig. 1.

Where Will Exploration Pay Off?

In an era of spiraling costs, management is screening prospective areas with utmost care. Here're some clues that might throw some light on this pressing problem

by Norman S. Morrisey
Drilling-Development Editor

STEADILY the new oil and gas reserves in the United States per foot of hole drilled are declining. Steadily the cost of finding new reserves is increasing. Each year we are forced to go deeper in exploratory drilling to find new oil.

Geophysical costs during the past 10 years have tripled. Salaries, too, have increased nearly 2.5 times the 1945 figures. Cost of equipping a well has rapidly increased during the last 10 years.

Oil companies are carefully screening the various oil provinces to find the answer to the question, "Where can we get the greatest return on our exploration dollar?" Fig. 1 and Table 1 provide some clues to the answer.

Louisiana is by long odds the best place to find big reserves, according to the chart. But even here, we must qualify the answer and specify certain areas. Much of the success in oil finding is concentrated in South Louisiana and in its offshore waters.

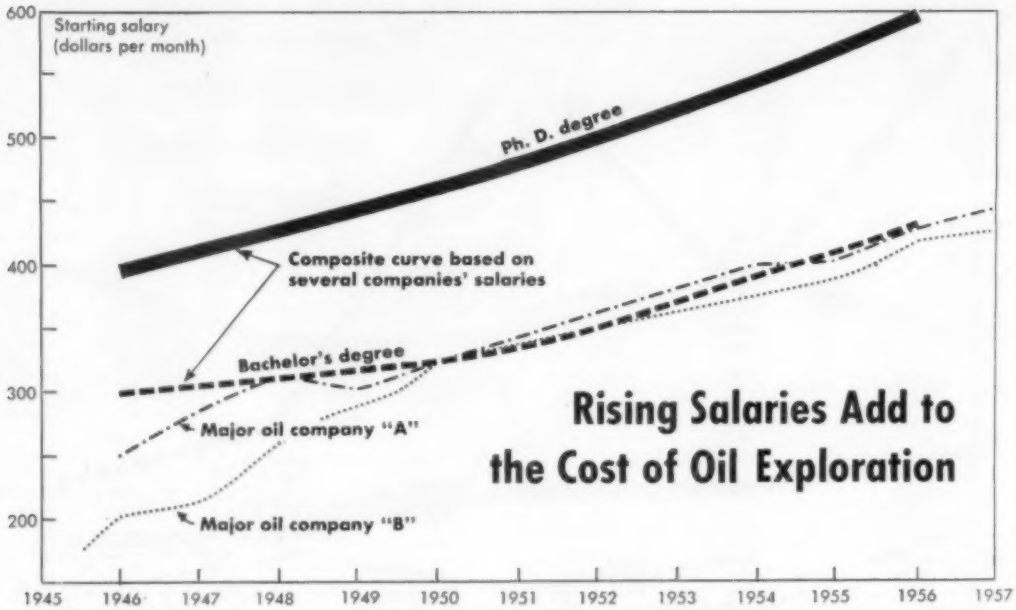
The Rocky Mountain area comes in second, but here oil finding is following the nation-wide pattern. Each year Rocky Mountain operators are finding less new reserves per foot of hole drilled.

But does this mean that it is un-

TABLE 1—WHERE IS OIL FINDING MOST SUCCESSFUL?
(Barrels of new reserves* added per foot of hole drilled)

	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956
United States	40	48	41	34	45	29	38	21	26	32
Louisiana	75	50	74	70	47	76	70	54	72	76
Rocky Mountains	113	111	50	91	138	76	82	16	36	40
Texas	50	61	52	34	58	21	30	21	31	28
Oklahoma	42	39	28	20	23	18	25	21	21	20
Kansas	37	26	16	14	13	29	29	16	18	19
Illinois	14	19	24	27	25	7	13	15	13	12

*Includes all wells, oil, gas, and dry; includes all reserves, crude, natural-gas liquids, and natural gas converted to crude energy equivalent.



STARTING SALARIES are a good barometer to show how rapidly some exploration costs have risen. Fig. 2.

profitable to look for oil in other areas?

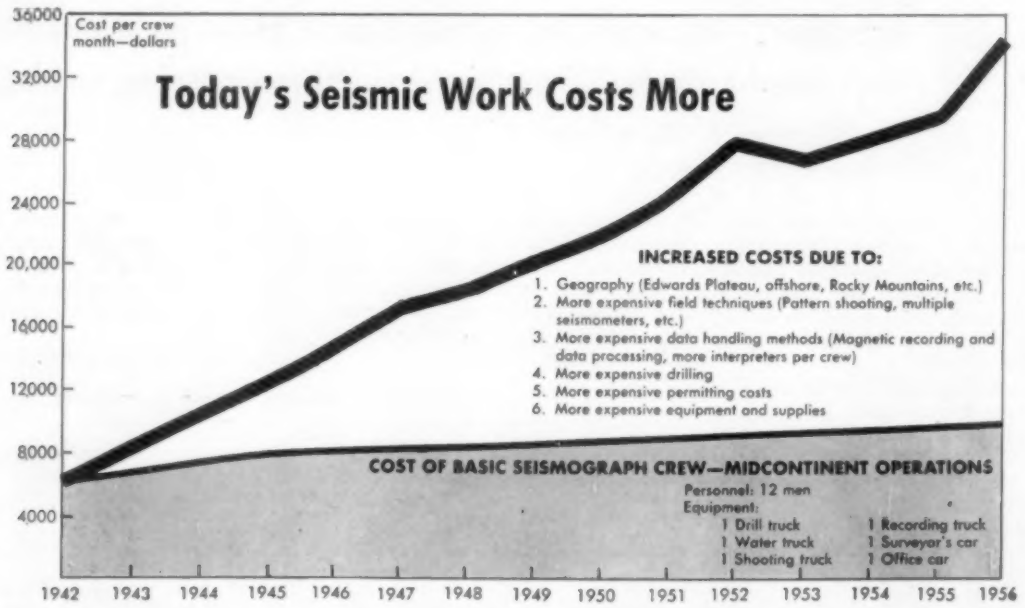
Emphatically no! Operators are still finding and producing oil profitably in all the important oil provinces. The chart simply shows those areas where the big payoffs may be expected. But these big payoffs require large outlays of cash for exploration, leasing, and drilling. Undoubtedly the best payoff at the moment can be expected in the Gulf of Mexico, but even here major companies have formed exploration syndicates to distribute the terrific burden that offshore exploration imposes.

Exploration in the Rockies is no snap. Aneth is probably the first major strike uncovered in 10 years of active exploration for some of the companies active on the trend.

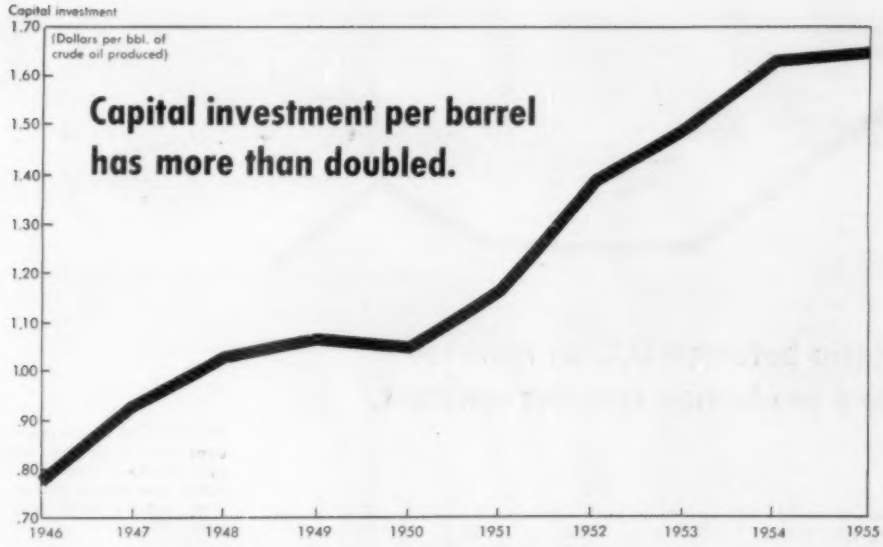
Cost of exploration . . . Many oil companies are seriously concerned over the rapidly rising costs of oil exploration in the United States. Starting salaries for young geologists with no experience have risen from $175 per month in 1945 to $420, $440 in 1957. (Fig. 2).

Geophysical costs have tripled, one major oil company reports, in the past 10 years. Surprisingly enough, the cost of a basic seismic crew (see Fig. 3) has risen only 20-25 per cent in 10 years. Other factors, however, have acted to accelerate the cost of geophysical work.

- Geography has played an all



GEOPHYSICAL COSTS have tripled for some companies in the past 10 years. Cost of a "basic crew" in the Mid-Continent has increased only 20-25 per cent, but other factors have contributed to boost costs as shown. Fig. 3.



CAPITAL expenditures for production facilities in the United States have doubled in 10 years. These figures exclude geological and geophysical expenditures and lease rentals. (From "Investment Patterns in the World Petroleum Industry" by Chase Manhattan Bank). Fig. 4.

important part in forcing the price of geophysical work upward. Ten years ago, most of the work was done in areas that were fairly easy to shoot. The difficult areas were avoided, particularly those where seismic results were uncertain at best. Today the only virgin territory left in the United States is in these hard-to-shoot areas. And in these areas geophysical costs mount rapidly. The Edwards Plateau of West Texas is typical. New and improved field techniques now permit geophysicists to get results that are usable. But these techniques—multiple shot-holes, pattern shooting, etc., all cost money.

- New methods of data processing are not cheap. The cost of a field magnetic recording unit is about equal to the cost of a complete recording truck. And a playback system will run as high as $150,000. Actual cost of processing the magnetic data will run $4,000-$5,000 per month over and above normal geophysical costs.
- Oil companies are paying more for interpretation today. In addition to the contractor's staff, each large oil company maintains its own staff of skilled interpreters.
- Permitting, or rather, the cost of permitting, was a minor item in seismic operations 10 years ago as a general rule. But here's what one contractor reported on permitting: ". . . an average monthly cost of permits on an operation we looked at for 1947 ran around $100; in 1956 (for the same area) this average monthly permit cost is about $8,000." Today permitting is a major expense in many areas, costing as much per month as an entire geophysical crew of 10 years ago.

In the Mid-Continent, geophysical work is a real bargain today. Contractors are readily available on short or long-term contracts. And costs are up only slightly over those of 10 years ago. However, geophysical costs in parts of Texas will cost $45,000 to $60,000 per month. Ten years ago the work could be done for one-third these figures. Seismic costs in South Louisiana are steadily climbing. On land, geophysical costs are up at least 100 per cent over the 1947 figure.

Water crews, too, are costly, running as high as $60,000 per month. However, the costs of water operations are low when figured on a cost-per-mile basis. At times, the daily output of a water-borne crew will equal the monthly output of a land crew.

Results of drilling . . . The finding and development cost of new reserves is rising all too rapidly. One large integrated company reports that its findings costs have increased 2.7 times in the past 5 years. And the recent study by Chase Manhattan Bank confirms this trend. Each new barrel of reserve is costing the industry approximately $2 in capital assets (See Fig. 4).

In the United States there is a fairly constant ratio between annual production and crude reserves. During the past 10 years, we have always maintained reserves equal to a 12-year supply at present rates of production (Fig. 5). However, during recent years, the ratio between total crude reserves and total U. S. consumption has declined. This can be attributed in large measure to imports. And we find that the U. S. today has less than 10 years' supply of crude oil based on actual oil consumption.

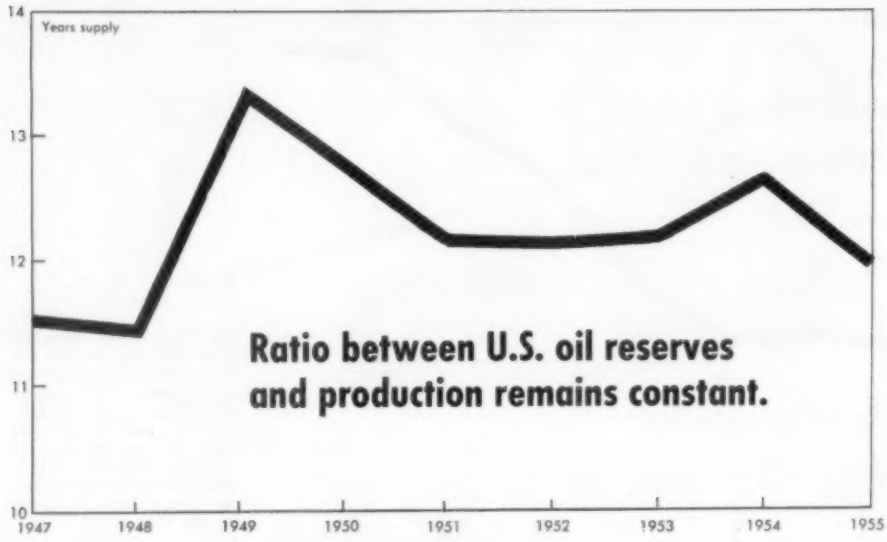
Louisiana . . . The Miocene sands of South Louisiana and offshore are consistently the most profitable pay sands in the country. Reserves are figured in terms of 500-800 bbl. per acre-foot of sand. Most of the reservoirs have active water drives and the sands are porous and permeable. Typical Miocene wells will have recoverable reserves on the order of 800,000 bbl. And offshore wells, because of the wider spacing, will have considerably better recoveries.

The Oligocene trend, too, is profitable, although it does not have as high recoveries as the Miocene.

North Louisiana has its share of highly profitable pay zones. The deep Smackover and Cotton Valley reservoirs are prolific, although more often than not, the Cotton Valley produces

HERE IS ONE MAJOR COMPANY'S EXPERIENCE OF THE COST ON DEVELOPMENT WELLS, EXPLORATORY WELLS AND COMBINED DRILLING

	1951	1952	1953	1954	1955
Field wells:					
Average depth, ft.	4,830	5,830	4,700	4,930	4,830
Cost per well	$67,000	$87,500	$70,000	$75,000	$70,000
Cost per foot	$13.85	$15.00	$14.90	$15.20	$14.50
Wildcats:					
Average depth, ft.	5,940	6,500	6,400	6,950	6,840
Cost per well	$97,000	$127,000	$117,000	$137,500	$184,000
Cost per foot	$16.50	$19.60	$18.30	$19.80	$26.95
All tests:					
Average depth, ft.	5,170	6,060	5,110	5,340	5,240
Cost per well	$71,700	$97,500	$78,300	$80,000	$92,500
Cost per foot	$13.70	$16.10	$15.30	$14.95	$17.65



IN SPITE of the increased costs of oil finding, the ratio between proved reserves and annual production remains fairly constant. Fig. 5.

gas and condensate rather than crude oil.

More recently, fracturing has given independents the opportunity to develop shallow production that was originally passed up. Louisiana's old Pine Island field enjoyed a lively play when it was discovered that the Annona chalk would respond well to fracturing. The peak of this has passed, but the play continues.

Rocky Mountains . . . The old reliable reservoirs of the Rocky Mountains—the Madison, Tensleep, Dakota, and Mesaverde—still account for a large volume of new reserves, but in many areas these pay zones are overshadowed by new producing zones. Deep production below the Madison in the Williston is becoming more important. The Siluro-Ordovician on the west side of the basin has recoverable reserves comparable to the Madison.

Paradox production was virtually unknown prior to 1956 in southeastern Utah. Now, however, there is an active drilling campaign aimed at exploiting this reservoir. Enough reserves have already been proved to justify the building of two pipelines with a combined capacity of 110,000 bbl. per day. Present plans are to have both completed by late 1958.

Another new pay zone is the lower Gallup sand in Bisti field of Northwest New Mexico. This sand too was virtually unknown as an important oil producer prior to 1956. Now, however, Bisti field has mushroomed into a significant strat trap.

Texas . . . Over-all, drilling results are on a par with national averages. However, prime drilling area in Texas is the Permian basin of West Texas. Here the principal deep targets are the Devonian and the Ellenburger. The latter has been a prolific reservoir since initial production was found in it at Big Lake 30 years ago. Reserves in the Ellenburger range from 10,000 to 25,000 bbl. per acre in many of the large structures.

Many independents play West Central Texas, concentrating their efforts in Stonewall, Fisher, Jones, Nolan, Taylor, Runnels, and Coke counties. In this general area there are numerous pay zones at shallow and intermediate depths. Many of the fields produce from several zones and the dual completions make the wells a very attractive venture.

East Texas is an old area, but is a classic example of how new thinking can completely alter the exploration picture. East Texas has at least 18 known salt domes that were considered very attractive oil prospects prior to 1956. British-American Oil Producing Co. overnight converted these domes into Grade A exploration prospects with the successful completion of a Woodbine oil well on the flank of the Hainesville dome. The resulting lease play spread rapidly across East Texas, North Louisiana, and into Mississippi.

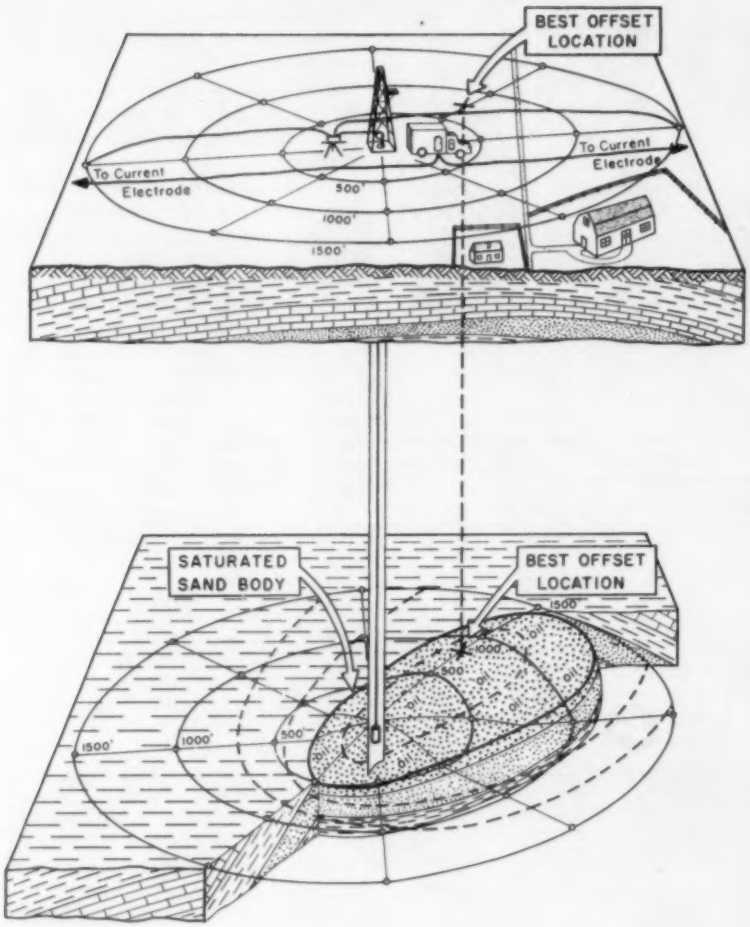
Mid-Continent . . . During recent years, oil exploration in the Mid-Continent has been largely concentrated in the older producing areas. Fracturing has made drilling for the tight Pennsylvanian sands a profitable venture. In these areas, the risks are low. For this reason the operators, mostly independents, are satisfied with low ultimate recoveries but a fairly rapid payout on inexpensive shallow wells.

Deeper drilling is confined to the southern part of Oklahoma and the Anadarko basin. Here, however, the low allowables discourage extensive drilling because of the long payout periods.

In northern Oklahoma, the Wilcox is still the prime reservoir, but oil companies are reduced to drilling for small pimples or microstructures. The big structures have all been found. Although small, these microstructures make an attractive target because of the high reserves.

Illinois . . . Stratigraphic exploration guides the drilling in Illinois. Much of the production is related to sand lenses at relatively shallow depths. Thus, the figures given in Table 1 may prove somewhat misleading since the average well depth in Illinois in 1956 was only 2,303 ft. This compares with an average well depth in the United States of 4,022 ft. And in Illinois there is very little gas production so that nearly all reserves are crude oil. Drilling is relatively inexpensive and aimed at developing sand lenses.

Where is oil exploration most successful? Undoubtedly South Louisiana, both onshore and offshore, and the Rocky Mountains top the list, with older oil provinces like West Texas equally good. However, any area can be converted overnight into a hotbed of activity, exploration and drilling if some new idea proves successful in finding or developing new reserves. In spite of the alarmists, the United States is not running out of oil. Fig. 5 shows this all too clearly. During the past 10 years, the ratio between known reserves and present annual production has remained nearly constant, averaging about 12.3 years' supply.



SANDEXSURVEY of a sand found at 3,000 ft. in the well helps operator spot the next location in this schematic diagram. Fig. 1.

Can Oil Be Found By Direct Methods?

Author claims good results from two techniques

by Frederick W. Lee

THE success of the use of geophysical measurements in finding mineral deposits is in direct proportion to the closeness of the relation of the effect measured and the material sought. Where the deposit itself is the source of the effect measured, that deposit can be located and outlined with a high degree of accuracy. Examples of such cases are:

1. Locating and outlining magnetic iron ore deposits with the magnetometer.

2. Locating oxidizing sulfide deposits by the use of self-potential measurements.

3. Locating salt domes by the use of the gravimeter.

4. Mapping the surface of bed rock by the use of refraction seismic measurements.

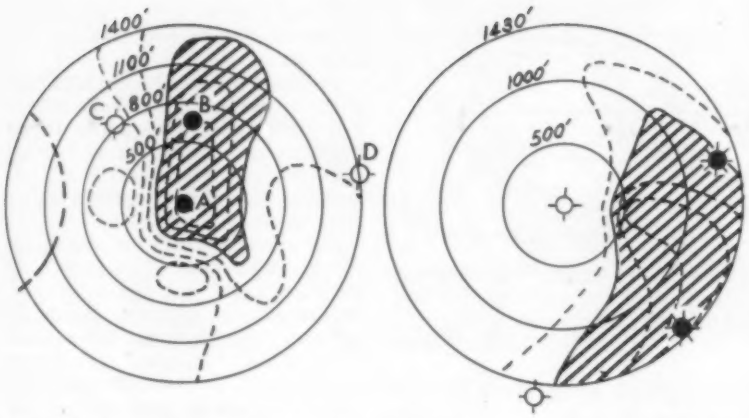
Finding structurally controlled deposits by use of geophysical methods is successful only in proportion to the frequency with which the controlling structures can be identified and to the proportion of the structures which carry values.

For example, many ore bodies occur in fault zones. And faults can often be found and traced by geophysical means. However, only small portions of the faults are mineralized. Therefore, having found and traced a buried fault geophysically, test drilling is required to find the ore deposits which the fault may carry. Likewise, oil accumulations sometimes occur at the crest of anticlines, on the flanks of salt domes, and against faults. But experience has found that only a relatively small number of such geologic structures actually contain oil accumulations. Therefore, although such structures can sometimes be found and properly identified by geophysical means, it is still necessary to prove the presence of oil or gas by test drilling. Statistically only about 1 out of every 10 well-defined and properly identified favorable structures carries commercial oil or gas. Thus, the drilling cost of every producing well is automatically multiplied by 10.

Direct method . . . To date only indirect geophysical methods have been in general use for oil exploration because it has been believed that there is no direct effect of an oil or gas accumulation which could be measured at the surface of the ground. However, it has been known for many years that oil or gas-impregnated sands in contact with shales carry rather large negative potentials. The electric well-logging technique which has been developed to such a high degree of perfection depends upon this effect. To date the use of this effect has been restricted to investigating the condition within a few feet of the drill hole.

"Sandexsurvey" . . . Because these potentials are so large and are distributed over such wide areas, it has seemed to the author that their effects should be detectable from measurements made on a much larger scale than those used in the conventional electric well-logging technique. Careful measurements made in both producing and barren areas have shown this to be the case. Where an open hole is available it is possible to outline the oil and gas-impregnated sand bodies in the vicinity of the well by use of a "Sandexsurvey" (sand exten-

The author is president of Lee Geophysical Survey Co., Baltimore.



SANDEXSURVEY showed the north offset to Well A as the best location. Wells C and D located on subsurface geology proved dry. Fig. 2.

SURVEY on a dry hole mapped an area of high conductivity to the east where production occurs. Fig. 3.

sion survey). And where holes are not available, initial drilling locations can be spotted by the use of Longcologs (ground polarization charts).

A Sandexsurvey is a technique of making measurements from a drill hole; this gives information regarding the location and extent of the oil and gas-impregnated portions of a sand penetrated by the well. Such a survey is made by:

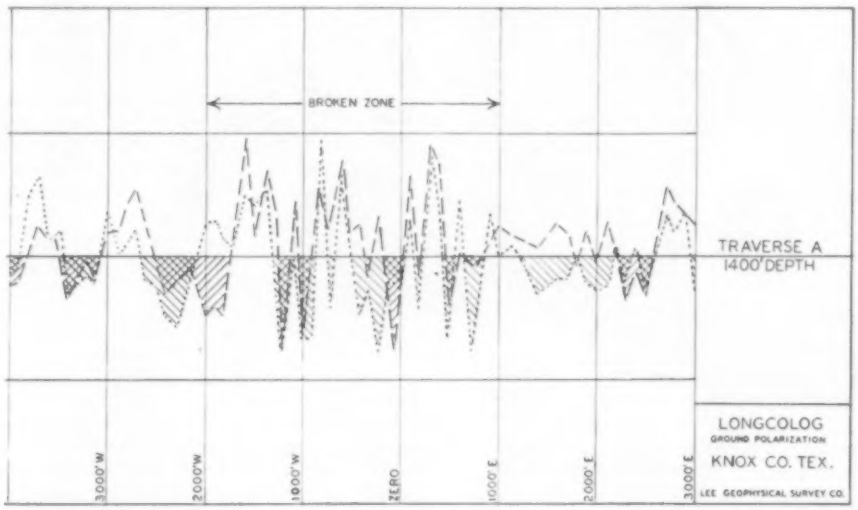
1. Lowering a nonpolarizing potential electrode into the well to the depth of the sand to be tested.

2. Setting other electrodes on the surface of the ground in a prescribed configuration.

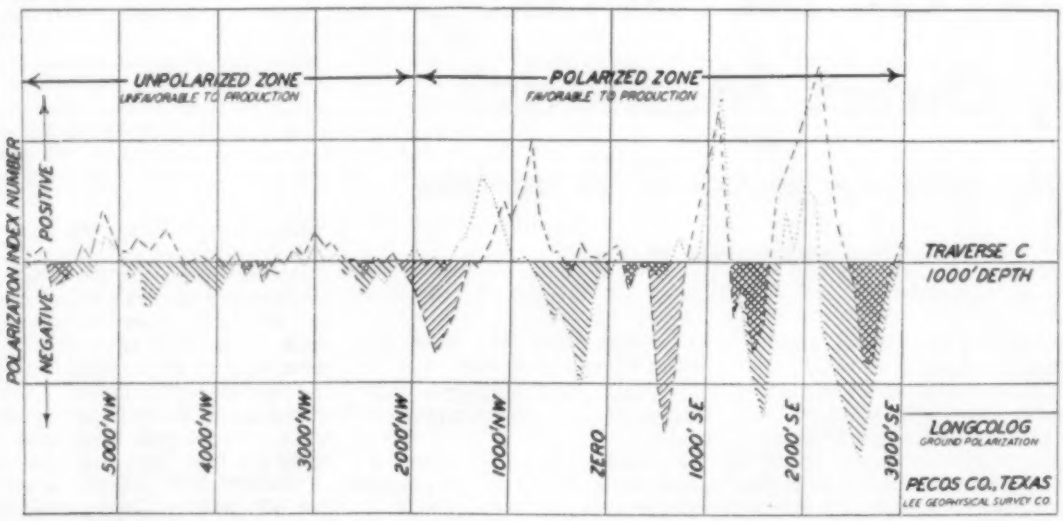
3. Passing measured electric currents between selected pairs of the surface electrodes.

4. Measuring the appropriate changes of potential between other surface electrodes and the in-well electrode.

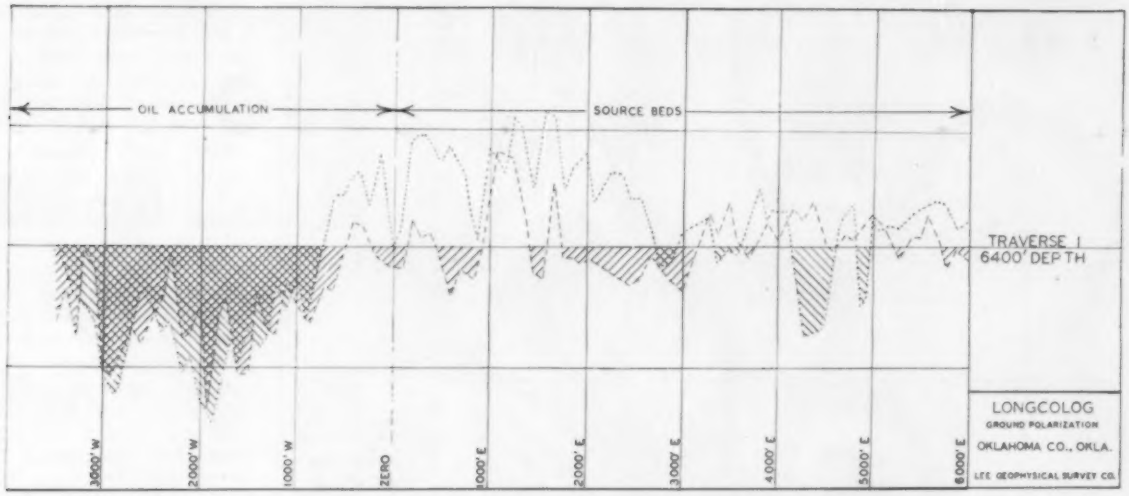
Fig. 1 shows the schematic layout used in making a Sandexsurvey of a sand at a depth of 3,000 ft. The current electrodes are outside of the diagram at a distance of 4,500 ft. from the well on the east-west line; they are left at the same location for all measurements made on this line. Potential measurements are made for all of the electrode positions shown along the east-west line. Each of the other lines is measured with the current electrodes at positions 4,500 ft. from the well on the line being measured.



HERE THE LONGCOLOG does not show significant agreement between the two curves to indicate substantial production. Fig. 5.



LONGCOLOGS are graphs with polarization index numbers plotted. Both curves must deflect in the same direction to be significant. Fig. 4.



HERE THE TWO CURVES are in agreement at the west end of the traverse. A marginal well was brought in about 700 ft. east of Zero tending to confirm the original interpretation. Fig. 6.

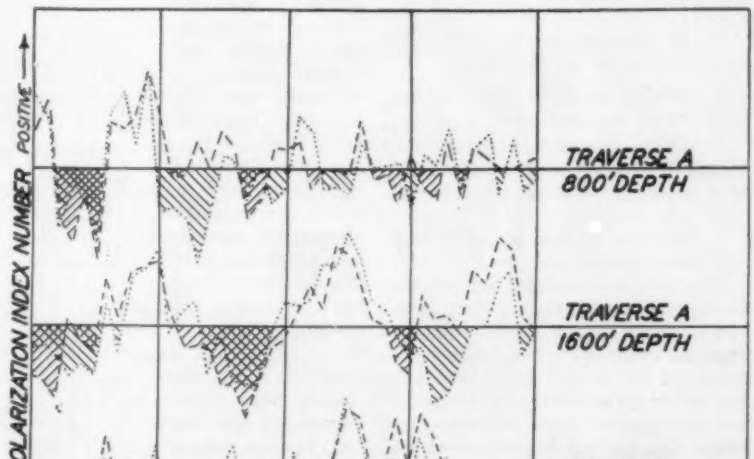
The applied current and the resulting potential change are measured for each position on all of the lines; the apparent conductivity is computed for each potential electrode location; and the value is entered on a map. These values are then contoured in the usual manner. One of the contours is then selected as representing the probable extent and outline of the impregnated sand body as shown in the lower portion of the figure. In any case where the ground is polarized, the point of maximum apparent conductivity is regarded as the most favorable offset drilling location.

It should be noted that the area covered by a Sandexsurvey is a circle of radius equal to one-half of the depth of the sand investigated, and that it is not necessary for the drill hole to penetrate the saturated portion of the sand for the survey to be effective. For this reason dry holes which prove to be on or near favorable oil-bearing sands should not be abandoned without first making a Sandexsurvey. This procedure will avoid abandoning leases which have values.

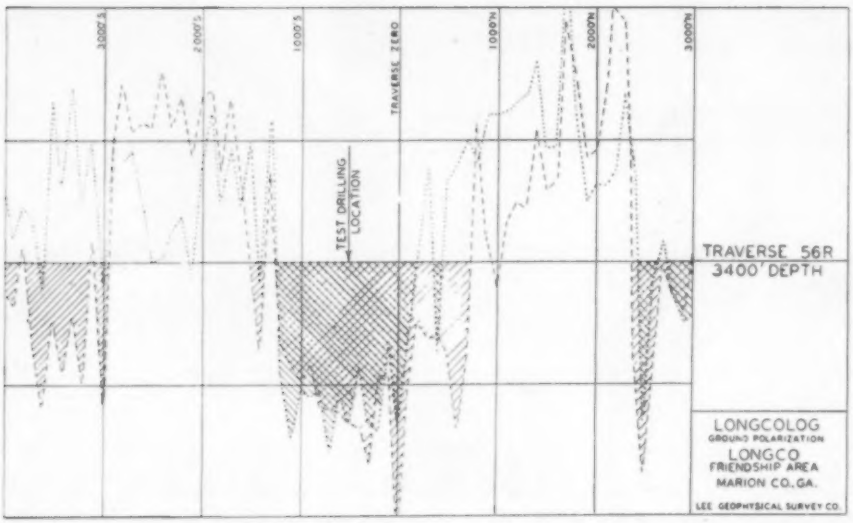
Sandex maps . . . A typical Sandex map of a producing well is shown in Fig. 2. The well in which the Sandexsurvey was made is shown at the center of the chart and was producing from a sand at a depth of about 2,800 ft. The Sandex map shows a region of high conductivity extending to the north of the well being surveyed; the best offset is indicated at a point 660 ft. north of the surveyed well. A well drilled at this point proved to be a slightly better producer than the original well. The wells to the northwest and east of the discovery well were drilled on the basis of good subsurface geology and turned out to be dry, thus proving the Sandexsurvey to be correct.

Fig. 3 is a Sandex map made from a dry hole which shows an area of high conductivity extending to the east and southeast from the hole. That this is producing area is proved by the two producing wells shown. A hole to the south and one to the northwest (not shown) were dry. This indicates that one of the most valuable uses of Sandexsurvey is to find production in the near vicinity of dry holes.

"Longcologs" . . . Careful study of the results of numerous Sandexsurveys revealed that certain of the effects of the electric charge on the impregnated oil sands could be measured from the surface of the ground without the use of the in-well electrode. These measurements are made through a system of electrodes in contact with and properly distributed over the surface of the ground. After the appropriate quantities are measured, the data are processed to produce "polarization index numbers"; these



HERE SEVERAL different depth curves are compared for the same traverse line. Best possibilities for production appear to be between 1,500 ft. west and 1,000 ft. east of zero at a depth of 1,600 ft. Fig. 7.



A TEST WELL was located on the strength of this survey as shown. The well was finally abandoned at a total depth of 4,010 ft. Fig. 8.

are used in plotting polarization charts known as "Longcologs."

A Longcolog is a graph with polarization index numbers plotted on the vertical axis and distance along the line of traverse plotted along the horizontal axis. For each point on the ground there are two polarization index numbers for each depth investigated; hence the Longcolog for a given effective depth consists of two curves, one for each set of polarization index numbers. To be significant any given feature must show the same way on both curves of the Longcolog.

Proper interpretation of the Longcologs will show the following:

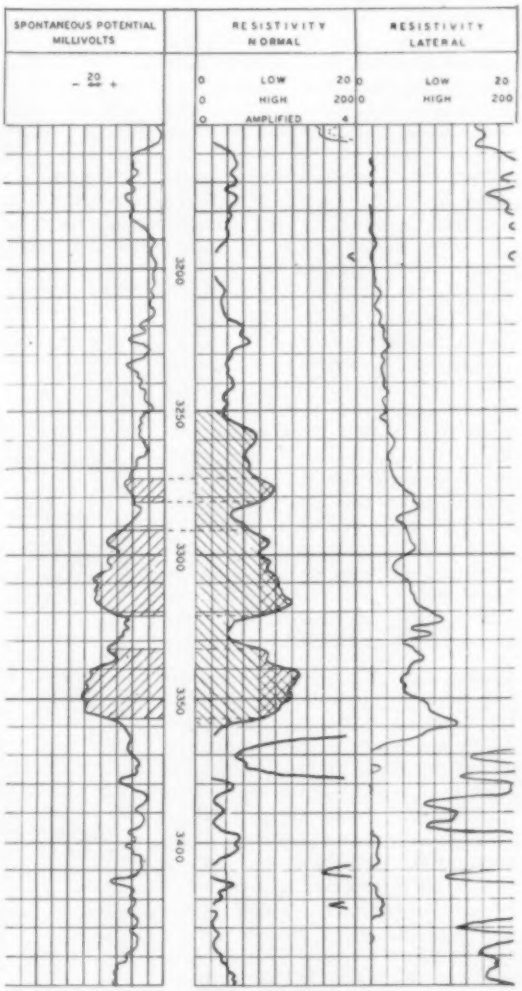
1. Whether or not the area is barren of oil or gas accumulations.
2. Which areas contain source beds.
3. Where and approximately at what depth the oil or gas has accumulated into pools.
4. Whether or not the cap rock has been broken.

The system is independent of the geologic features such as domes, anticlines, noses, faults, etc., generally regarded as favorable to the accumulation of oil or gas pools, but will also locate accumulations in pinchouts and stratigraphic traps with equal facility. The method is well suited for use in wildcat areas.

The following figures are sample Longcologs. Fig. 4 resulted from a traverse which was run in Pecos County, Texas. The southeast portion of the traverse crossed relatively heavily polarized ground. Conversely the ground crossed by the northwest end of the traverse is remarkably free of polarization. There is now a producing oil field in the area crossed by the southeast end of this line. And the edge of the field coincides closely with the change from polarized to unpolarized or barren ground.

Many times, although some polarization is shown on the Longcologs, it is of such a nature that substantial production is not indicated. This can be due to either broken cap rock or pools of insufficient size. Fig. 5 is a Longcolog which shows a broken condition of the cap rock. Fig. 6 shows the presence of marginal production which has been termed "source beds" under the eastern portion of the traverse and a good pool at the western end. The correctness of the interpretation is shown by the presence of a marginal well which was drilled about 700 ft. east of zero on Traverse 1.

By use of the method it is not only possible to locate potential oil fields by mapping the polarized areas, but it is also possible to pick out the approximate depth of the potentially producing horizons. Fig. 7 illustrates the "focusing effect" resulting from measuring several depths. The data were gathered for depths of 800, 1,600, and 2,800 ft. Study of the three different sets of curves reveals that the set for 1,600 ft. shows the highest degree of correspondence between the two curves of the pair, especially in the interval between 1,500 ft. west and 1,000 ft. east of zero. This indicates that within this interval any oil or gas production would probably be best at between 1,400 and 1,800 ft.



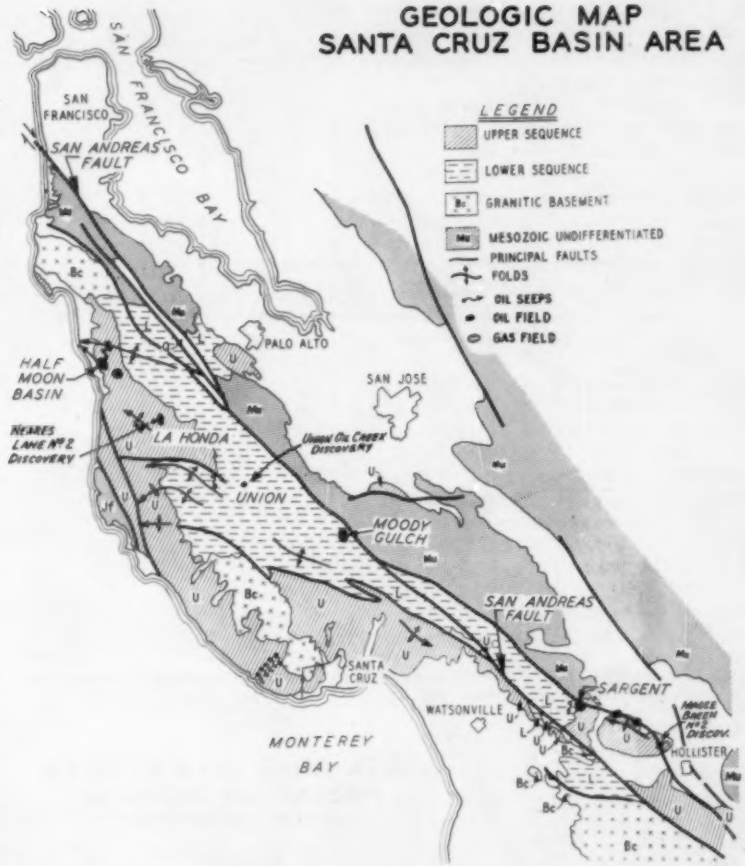
PORTION OF THE ELECTRIC LOG on the well shown in Fig. 8. The well was located in Marion County, Georgia and operator failed to establish commercial production. Fig. 9.

OIL IN THE REDWOODS

Santa Cruz Basin Holds Important Promise

Car-window geology has provided most of the field data in recent years

by Edward A. Gribi, Jr.



GEOLOGIC MAP of Santa Cruz basin reveals its complex structure and relationship to oil and gas occurrences. Fig. 1.

THE Santa Cruz basin oil province of central coastal California is one of the more geologically obscure basins in California. The towering redwood forests with their fern and moss carpet provide beauty and recreation for tens of thousands of people from the nearby San Francisco Bay area, but this beauty blankets the outcrops so necessary for the field geologist engaged in oil exploration. Even "creek-bottom" geology, a useful technique in many brush-covered California areas, is frustrating here. "Car window" geology—the detailed mapping of outcrops in the available roadcuts—provided most of the useful and reliable field data in recent years.

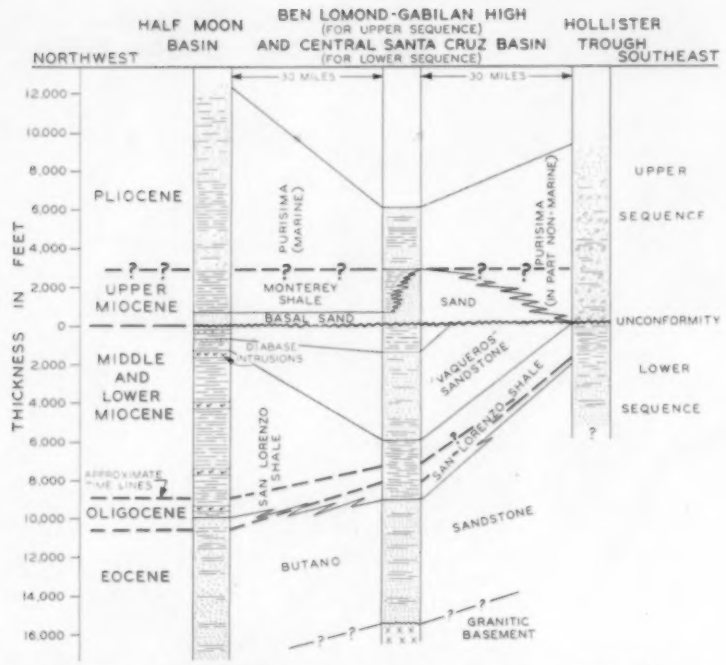
Systematic sampling of shales in these outcrops for micropaleontologic analysis has resulted in the solving of many stratigraphic riddles in combination with the car-window effort. In fact, scouts could follow the trail of major-company geologists through the Santa Cruz Mountains in the late forties and early fifties by looking for little holes in roadcuts where geologists dug out unweathered micropaleontologic samples or exposed a strike and dip a little better.

In the last 5 years at least one company has been taking micropaleo samples in areas of no outcrop by means of an auger rig mounted on a jeep. This technique was at least partially responsible for the Union Costa No. 1 location (Oil Creek pool) and subsequent discovery producing 81 bbl. daily of 43° oil from the Butano sand at 2,060-2,206 ft. in the fall of 1955. This discovery triggered a land and drilling boom that has revitalized the area in the last year.

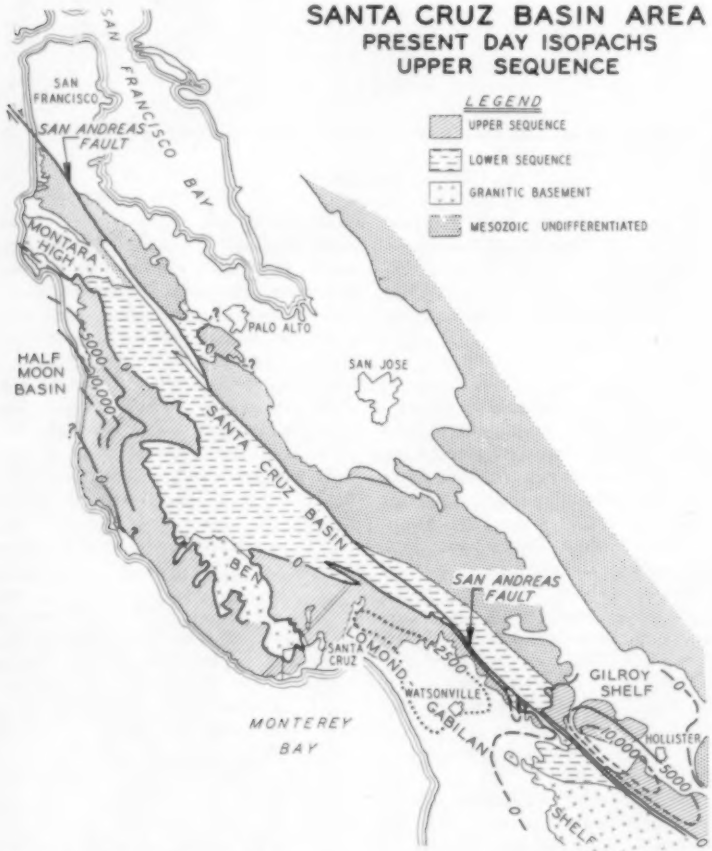
An old oil province . . . The area is actually one of the oldest oil-producing areas in California. Oil seeps have long been known throughout the area. They were the subject of drilling and mining operations for illuminating oil as early as 1865 in the Half Moon Bay and Moody Gulch localities. Small wells produced high-gravity oil as late as 1948 in both these areas, but production was never great at any one time. Sargent field was first drilled on seeps in 1886 and had produced 780,000 bbl. of 20° oil when it was abandoned in 1948. Several shallow wells have been drilled in the area in the last several years, apparently as stripper operations.

Wildcats have been drilled sporadically throughout the area, but the first real systematic exploration by major companies did not start until the late thirties. The late forties and early fifties saw campaigns of field work, leasing, and occasional drilling under way. Small amounts of oil and gas were discovered in the Hollister area during this period, setting off small but intense leasing and drilling plays. The only sustained "boom," however, was set off by the Union discovery in late 1955. Even here the geologic complexity and the problems of accessibility ($40,000 roads to the drill site and whipstocking from islands) make it questionable whether a major company can consider this particular discovery commercially successful.

Recent strikes . . . Two 1956 events hold more promise for commercially profitable exploration. Harry Magee reentered the Tidewater 1 Breen (19-12s-5e, Hollister area, drilled in 1953) and established an initial potential conservatively rated at 250 bbl. of oil per day from fractured Franciscan basement rocks between 3,804 and 4,000 ft. Unfortunately, deepening found water which could not be shut off in this hole, but rate of flow and pressures indicate that a substantial



STRATIGRAPHIC SUCCESSION in Santa Cruz basin, with approximate thicknesses, in northwest-southeast progression. Fig. 2.



PRESENT DAY ISOPACHS on the upper sequence beds reveal thickening in Half Moon basin and Hollister trough areas. Fig. 3.

reservoir is present and is a desirable target for further development.

In October 1956, the Neaves Petroleum 2 Lane (17-7s-4w, Half Moon basin) was completed for 75 bbl. daily reportedly from the Butano sand at around 1,700 ft. This well is significant for two reasons: (1) The outcrops are Purisima, relatively undisturbed by faulting and folding in contrast to the area of the Oil Creek discovery. In fact, the location is in a northwesterly plunging surface syncline. (2) If production is from Butano as reported it places the Butano at a very shallow depth in relation to nearby wells. It means that the location is on a pre-Purisima structural high that had eroded all the San Lorenzo and igneous rocks (that are several thousand feet thick in adjacent wells) leaving Purisima rock resting uniformably on the Butano. This well, incidentally, is within sight of the very old La Honda pool which produced small amounts of high-gravity oil for many years.

General Geology

The Santa Cruz basin oil province is a highly compressed structural and stratigraphic basin extending from Half Moon Bay, through the Santa Cruz Mountains, and perhaps extending across the San Andreas fault to include the Hollister basin to the southeast. It is bounded on the southwest by Ben Lomond-Gabilan granitic shelf and on the northeast by the Montara granite mass and the Gilroy and extended shelf composed of undifferentiated Mesozoic rocks (mostly Franciscan formation).

Stratigraphy . . . The Tertiary rocks of the region can be divided into two sequences separated by an angular unconformity.

The upper sequence includes rocks of younger Miocene to Pliocene age. The sequence is thickest in the area of Half Moon depositional basin (10,000+ ft). and in the Hollister

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Edward A. Gribi, Jr., is geologist for Bandini Petroleum Co., Los Angeles. A California native, he received his B.S. in geology from Stanford University in 1948. He then served Phillips Petroleum Co. as reconnaissance geologist, Sinclair Petroleum Co. as a junior geologist in Ethiopia, and General Petroleum Co. as assistant geologist. He is a producer, with production in Bannatine field, Teton County, Montana. This paper was presented at the Pacific Section meeting of the A.A.P.G., S.E.G., and S.E.P.M., in Los Angeles.

PALEOGEOLOGIC MAP of Santa Cruz basin. Fig. 4.

ISOPACHS on lower sequence strata indicate thickness of 10,000 ft. and more in Santa Cruz mountain area, and absence by erosion in southwest. Fig. 5.

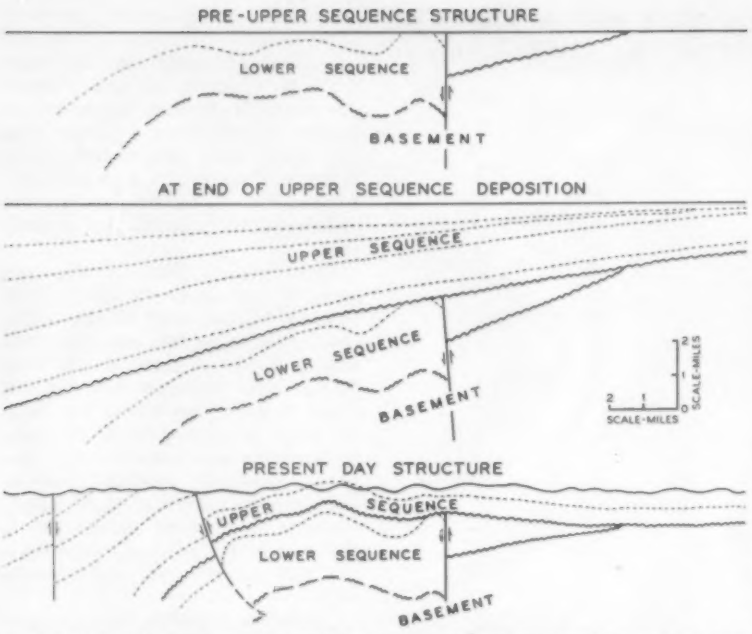
depositional basin (8,000+ ft). It is 1,000 to 3,000 ft. thick over the Ben Lomond-Gabilan shelf and less than 1,000 ft. thick on the Gilroy shelf. The Pliocene Purisima formation is largely diatomaceous, punky, and silty shales with interbedded sands. In the Hollister area it is in part nonmarine. The Upper Miocene portion includes siliceous shales and a basal sand.

The Purisima formation has oil seeps in outcrop in the Half Moon basin area and near Sargent field. Small production has occurred from lensing Purisima sands in the Half Moon and Hollister basins. The upper Miocene basal sand has large tar seeps in outcrop along the west flank of the Ben Lomond high. The upper sequence overlies lower-sequence rocks in the areas of upper-sequence depositional basins, but in the areas of thin upper-sequence rocks the thin section rests on basement rocks.

The lower sequence includes rocks of Eocene to older Miocene age. It is more than 10,000 ft. thick in its structural basin in the Santa Cruz Mountains, but it is absent to the southwest by erosion. Several thousand feet of the sequence are present in the Hollister basin but are absent on the Gilroy shelf. The older Miocene and Oligocene rocks are largely siliceous shales that are difficult to correlate without microfossils. They include an upper shale unit, an interbedded sand, and the San Lorenzo shale. The transitional Butano sandstone-San Lorenzo shale contact ranges from mid-Oligocene in the Half Moon basin area to upper Eocene in the central Santa Cruz basin. The Butano sandstone is a thick unit of massive sandstone with interbedded shale. It rests generally on granitic basement west of the San Andreas fault, but Eocene shale rests on Franciscan "basement" (Mesozoic undifferentiated) in a small area west of Palo Alto.

Lower-sequence rocks have surface oil seeps at various places throughout their outcrops. Fractured San Lorenzo shale has produced small amounts of high-gravity oil for many years in Moody Gulch field. The Butano sand has been the main target of exploration in the Santa Cruz basin for the last 20 years, and there have been many near misses, the difficulties being either in poor permeability or in completion technique. The Union Oil Creek Butano sand discovery of 1955 has been mentioned above. Fractured Franciscan "basement" production in the Hollister area has also been mentioned.

Structure . . . The structural pattern



STRUCTURES in lower sequence rocks prior to upper sequence deposition probably will not coincide with location of present-day structures. Fig. 6.

of the region is dominated by the right lateral San Andreas fault movement. The Ben Lomond granite mass moving northward, therefore, has compressed sediments to the north of it into steep folds with occasional south to north overthrusting. East of the mass this compressive force sliding alongside has caused the development of sharp folds highly broken up by strike-slip faults with a trend roughly parallel to the San Andreas fault. This same type of structural situation exists in the Hollister basin between the San Andreas fault and the Gilroy shelf. Thus the Santa Cruz basin is a highly mobile belt lying between two buttresses with opposing relative movement—the Ben Lomond granite mass and the Gilroy Franciscan self.

The geologic history of the region is complex. The exact area of original lower-sequence deposition is probably far greater than the present area of its occurrence. This depositional basin existed well into middle Miocene time, but in late middle and early upper Miocene time a period of uplift and erosion occurred that folded and faulted this series of rocks and stripped them from the Ben Lomond-Gabilan high and the Montara-Gilroy high. At the same time a series of basic intrusive and extrusive igneous rocks affected the area around the present southeast end of the Half Moon basin. This period of diastrophism apparently gradually died out so that by mid-Pliocene, normal deposition was proceeding over the entire area. The Half Moon basin and the Hollister basin were both strongly subsiding areas during all of Pliocene and as a result they received many thousands of feet of sediments in contrast to the thin sections over the shelf areas. The greatest period of deformation appears to have been in Pleistocene and Recent time—intense faulting, folding, uplift, and erosion are still continuing.

Migration and Accumulation Problems

The complex geologic history of the area indicates that control of migration and accumulation of hydrocarbons is equally as complex. Permeability lenses and wedges of likely reservoir rocks as well as blanket sands occur in both upper and lower sequences. These zones have been affected by uplift erosion, faulting, and folding in at least two distinct periods of geologic history. Thus the most likely appearing present-day prospects may be dry because they were not in a position to trap oil prior to the most recent deformation. On the other hand, areas with no present-day structural indications may be the location of some earlier uplift that formed a trap for hydrocarbons.

The Neaves Lane No. 2 discovery is an excellent example of this type of trap and points up the importance of considering geologic history in finding and evaluating prospects. For instance, in Fig. 6 it can be seen that oil trapped in structures in lower-sequence rocks prior to upper-sequence deposition will in many bases not coincide with the location of present-day structures. Oil migrating in upper-sequence rocks due to initial regional dip may have moved out of many areas of existence of present-day structures in upper-sequence rocks. Therefore, successful exploration will involve a high degree of collection and collation of surface and subsurface information in order to determine the significant factors in geologic history that control the localization of hydrocarbon deposits.

Factors other than geologic will no doubt play an important part in oil development in the Santa Cruz basin. For instance, drilling costs will probably average higher per foot than elsewhere in California because of the high cost of accessibility. The mountainous timber-covered terrain requires expensive road-building projects that in some cases equal the cost of drilling. Union partially solved the problem in its Oil Creek discovery area by drilling several wells from the same drilling "island."

Another handicap to development is the land situation. The private lands are either large tracts held by family or company groups, often difficult to deal with, or they are myriad small tracts in the recreational area. Most of the lands are now held under lease by four or five major companies.

On the positive side, the Santa Cruz basin is certainly a potentially important oil province. Its location adjacent to a large metropolitan area indicates that oil or gas in any quantities can be readily utilized. It is a sedimentary basin 75 miles long that contains a sedimentary section that aggregates as much as 25,000 ft. The density of surface oil seeps is great and there has been enough oil and gas production established over the years throughout the region to indicate that it is certainly a highly petroliferous basin. Structural and stratigraphic traps have been formed at several times during the geologic history of the region. The challenge now is to unravel this history and to unravel what may well be the myriad traps containing oil and gas.

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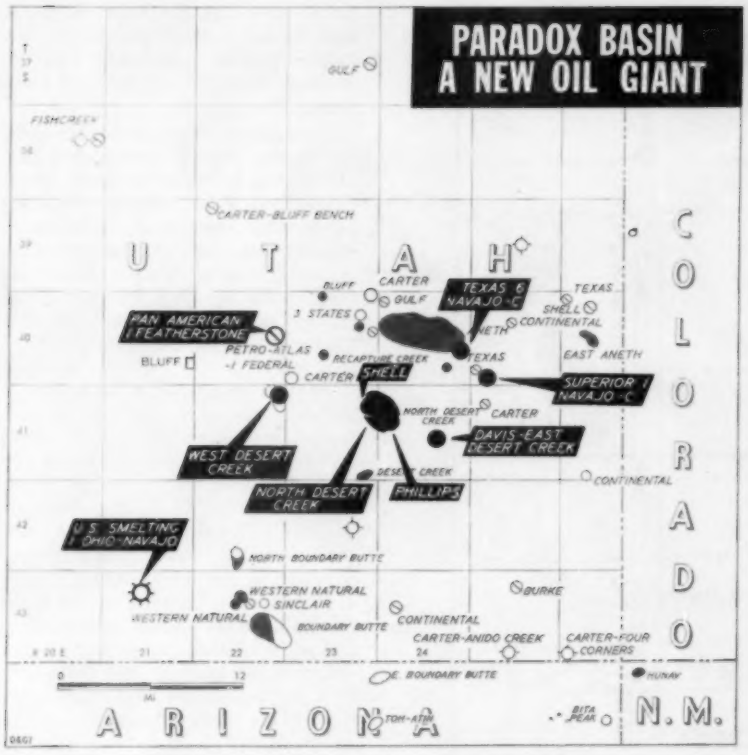


Rockies place two contenders for '57 honors. No. 1 is

PARADOX BASIN . . .

. . . Once scorned, it's now a glamorous Cinderella

John C. McCaslin

THE Paradox basin of the Four Corners region is bearing out earlier predictions of being the nation's top oil province in 1957. By early March this newly emerged oil giant already had eight new oil and gas discoveries and a multitude of active and planned drilling locations.

As a wildcatting paradise the basin is really just 1 year old. It all began early in 1956 at Aneth. As the months went by, Bluff, North Desert Creek, Hunav, Toh-Atin, Bita Peak, and East Aneth were opened. By the end of 1956 the basin had 16 fields—and by March 1 there were 22. Aneth trend reserves alone were estimated at 100 to 300 million barrels.

The long string of Pennsylvanian discoveries last year now appears to be swamped by the avalanche of new strikes throughout the San Juan County, Utah, oil-hunting ground since January 1. Five short exploratory weeks have made the map makers dizzy. Here's the Paradox story thus far in 1957:

. . . Davis Oil Co. 1 Navajo-A. The newest addition to the Paradox basin oil coffers is Davis Oil Co.'s Paradox-Pennsylvanian producer in C NE NE 27-41s-24e. This East Desert Creek field opener is 4½ miles southeast of North Desert Creek field and 5 miles northeast of Desert Creek field. The well was flowing oil at the rate of 45 bbl. per hour from perforations at 5,510-90 ft.

. . . Featherstone. At the first of March Pan American Petroleum Corp. reported an oil flow of 6 bbl. per hour on drill-stem test of its 1 Featherstone wildcat, 3 miles west of Recapture Creek field.

This wildcat, if successful, would move Aneth trend production to its westernmost point. It lies 5 miles east and a little north of the town of Bluff, Utah, and 2 miles north of West Desert Creek.

. . . West Desert Creek. This southwestern anchor to the Aneth region trend was opened at Gulf Oil Corp. 1 Desert Creek - Indian, 3½ miles southwest of Recapture Creek field. The discovery well flowed 263 bbl. of oil per day on 12/64-in. choke from perforations in the Paradox-Pennsylvanian at 5,800-10 ft.

. . . Superior 1 Navajo-C. An unnamed Paradox oil field was opened 3 miles southeast of the south side of Aneth field proper at Superior 1 Navajo-C. Information on this well has not been released due to land litigation between Utah and the Navajo Indians. It is the first producer in Range 25e. Reports from the basin indicated that this well is among the best producers in the current play.

. . . West Boundary Butte. An Hermosa - Pennsylvanian gas field was opened by U. S. Smelting, Refining & Mining Co. at 1 Ohio-Navajo, 6½ miles west-northwest of North Boundary Butte field. This westernmost producer in the Paradox basin flowed gas at the rate of 9,500 M.c.f. per day on tests at 4,842-4,910 ft.

. . . North Desert Creek. This Paradox basin field is the second biggest producer. There are four wells in the field. Phillips Petroleum Co. and Shell Oil Co. both added important wells to the field.

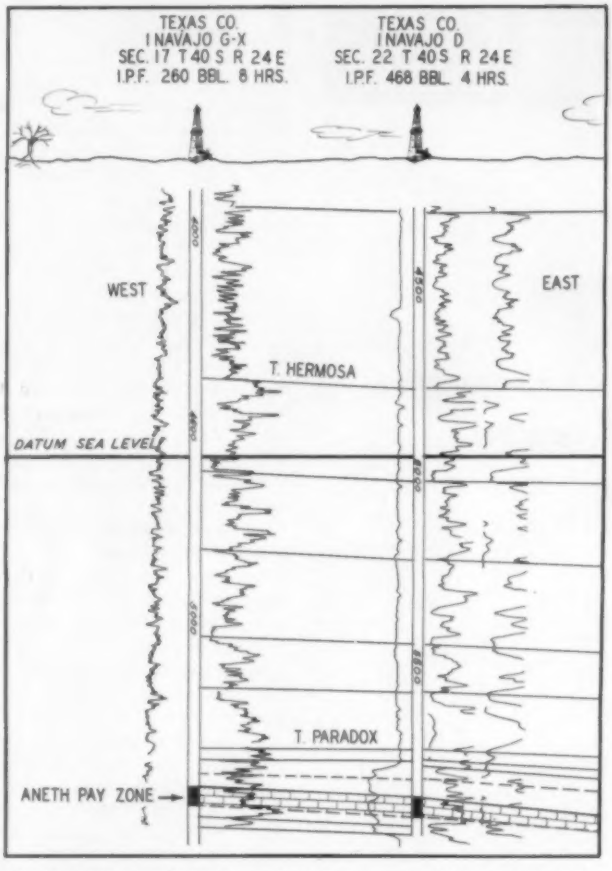
Phillips-Aztec 1 Desert-A, a long extension on the southeast end of the field, flowed 631 bbl. of oil in 6 hours on 1-in. choke; 410 bbl. on 25/64-in. choke in 10 hours. This is one of the best flowing wells to date in basin activity. Superior Oil Co. added a well late in February on the north side of the field.

Shell Oil Co. 22-12 North Desert Creek flowed at the rate of 720 bbl. of oil per day on tests of the upper Hermosa-Pennsylvanian at 5,275-5,340 ft., establishing a possible new pay for the field, a Paradox-Pennsylvanian producer. The well, however, was completed in the Paradox.

. . . Dual completion. The Texas Co. 6 Navajo-C is the first multiple-pay completion in the Paradox basin. This well is ¾ mile south of Aneth field proper. It was completed for a combined flow of 3,462 bbl. per day from the Ismay zone and the Aneth zone. This is the best gage of any well in the basin.

And Now?

Drilling momentum in the Paradox basin is even higher than was earlier expected. Wildcats are drilling as far north as 23e-37s, and as far southeast as 26e-43e. New locations are being staked in nearly every township



ANETH FIELD PROPER has estimated oil reserves of 100 to 300 million barrels. Here are logs of two of the field's big producers.

in San Juan County, Utah, and are now being reported east across the state line in Montezuma County, Colorado.

The Aneth trend itself is more than 20 miles long and is growing with each westward of eastward discovery. The east anchor is at East Aneth near the Colorado line; the west anchor is Recapture Creek, but success at Pan American's Featherstone wildcat will move it 3 miles farther west.

Considerable exploration is under way in the extreme southeastern corner of Utah at Boundary Butte, Anido Creek, and Four Corners. Two gas fields were opened in northeastern Arizona last year, and one oil field in northwestern New Mexico at Hunav. We can look for more wildcatting along the southeastern and southern rim of the Paradox basin this year.

The Paradox basin is the largest of the three basins in the Four Corners region. It is one of the nation's newest and most promising future oil provinces. The surface is barely scratched. The Aneth discovery and consequent development success throughout the basin is a long step forward in the long-awaited discovery cycle that appears to be here. The industry is finding strat traps by use of facies and stratigraphic studies. Aneth is the prize of this study.

A. I. Levorsen told the recent meeting of the Rocky Mountain section of the A.A.P.G. that "Trap thinking must replace structural thinking if the great oil and gas potential of the Rocky Mountain region is to be realized."

The discovery of oil in the Paradox basin seems to indicate that Rocky Mountain oil hunters are moving out of the structural period and entering a new era of stratigraphic search. One thing is certain—the nation has a new prolific source of oil in the Paradox.

. . . and No. 2 is

WILLISTON BASIN . . . This area may record its best discovery year to date

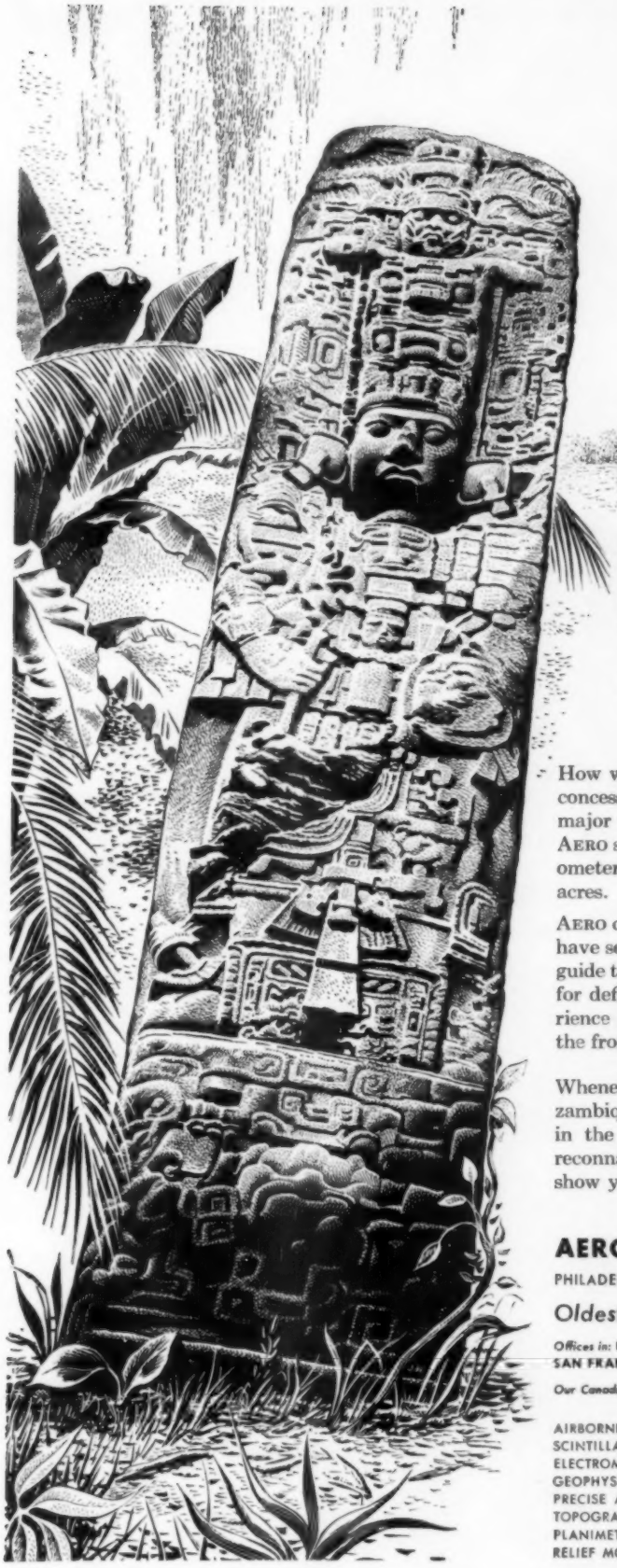
THIS year may well be one of the Williston basin's most important discovery periods since Beaver Lodge. Since January 1 Williston has seen two of the most significant and prolific strikes in its drilling history—Outlook and Rocky Ridge. Amerada Petroleum Corp.'s Outlook - Silurian discovery in Sheridan County, northeastern Montana, and Northern Pump Co.'s 1 Fritz, a Heath sand strike in Billings County, North Dakota, have awakened sleepy exploration interest throughout the basin. These two discoveries overshadow other important Williston happenings since the turn of the year.

Outlook

Amerada's prolific discovery at Outlook in northeastern Montana is the most important exploratory event in this section of the Williston basin since Poplar. The 1 Tange flowed 2,742 bbl. of oil per day from the Silurian at 9,056-74 ft.

. . . Outlook opened first production in Sheridan County.

. . . Location is 29 miles northeast of nearest production at Northeast Bredette field, Daniels County.



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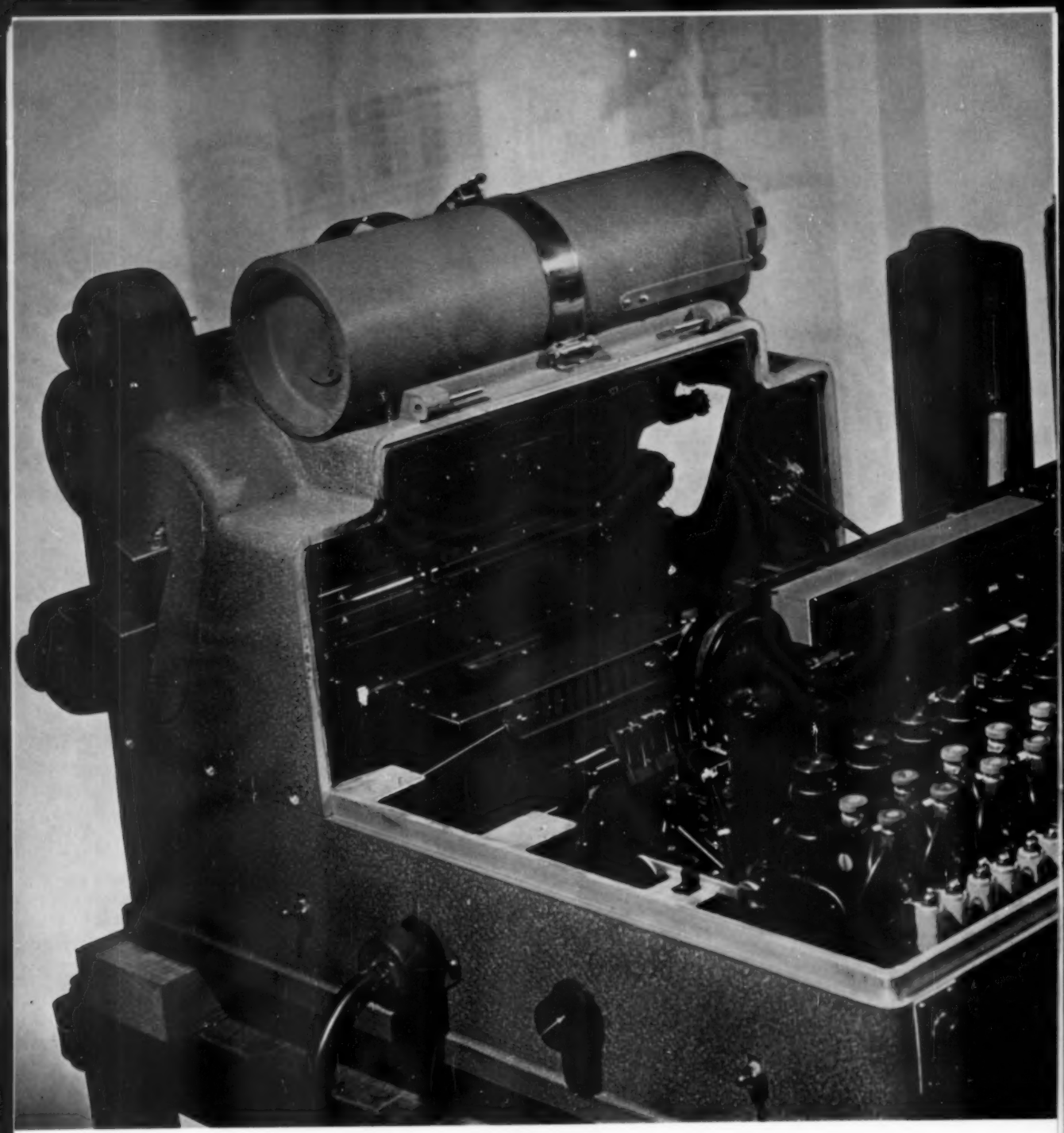

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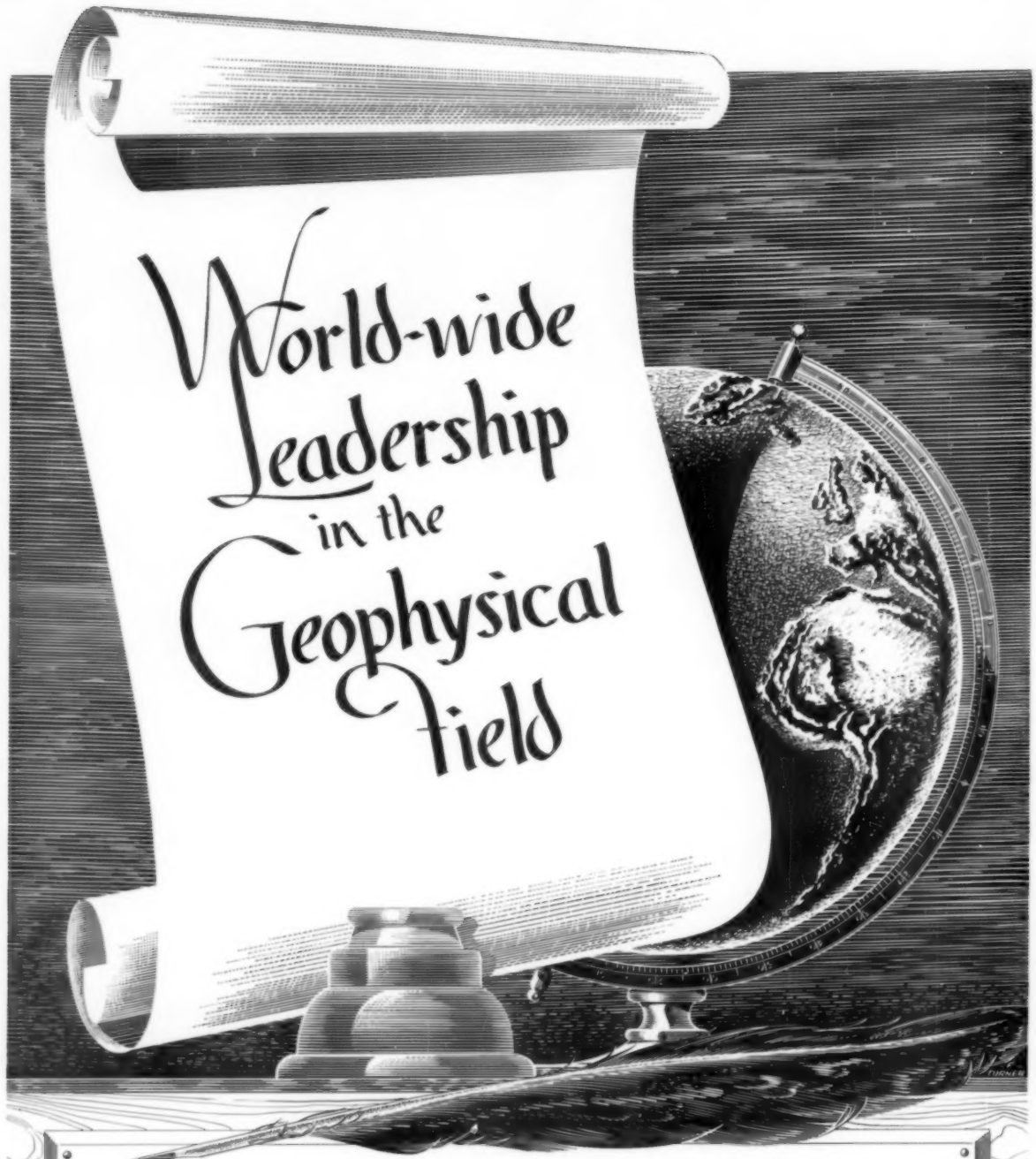

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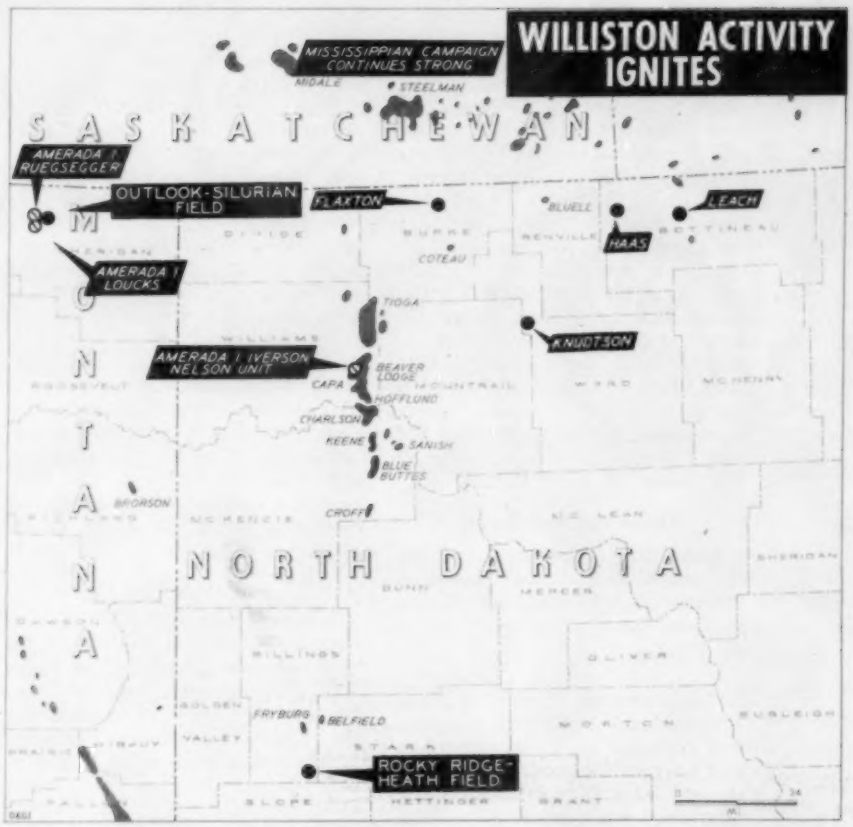
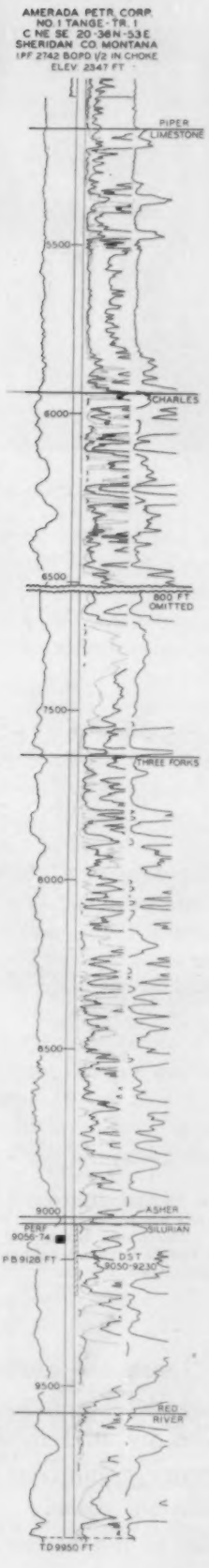


BIG WILDCAT NEWS is expected in the Williston basin in 1957. Two of the region's most important discoveries since Beaver Lodge are going a long way toward bearing out this prediction.



LOG for the Outlook discovery well in Sheridan County, northeastern Montana. This prolific Silurian discovery is the exploratory highlight of the year in the Williston basin.

. . . Closest Silurian production is 92 miles southwest at Southwest Richey.

. . . The 1 Tange was drilled in the center of vast untouched acreage.

. . . Silurian success at Outlook shows the tremendouts potential of Silurian rocks in the Williston basin where few wells have been completed in this zone. North Dakota has no Silurian production at all, although the Beaver Lodge discovery well flowed oil from that formation several years ago.

The Outlook area is now the most closely watched drilling project in the Williston basin. Amerada has two wells under way in the immediate vicinity of the discovery well, the 1 Loucks, and the 1 Ruegsegger.

Loucks . . . As of March 1 Amerada was coring at 9,942 ft. at this first follow-up try in the Outlook field area. Oil was recovered on drill-stem test of the Red River-Ordovician at 9,900-40 ft. Recovery was 30 ft. of free oil, 3,446 ft. of gas and oil-cut fluid, 30 per cent oil, including a 2,440-ft. water cushion and 372 ft. of mud-cut oil, about 60 per cent oil.

A test of the Silurian zone at 9,228-40 ft. got 72 ft. of free oil, 1,830 ft. of oil and gas-cut water cushion and 680 ft. of oil and gas-cut mud. Cores at 9,470-9,513 ft. and 9,580-9,734 ft. had oil shows. Oil shows were scattered in a core at 9,895-9,940 ft.

The Loucks is 4 miles southwest of the Outlook discovery well.

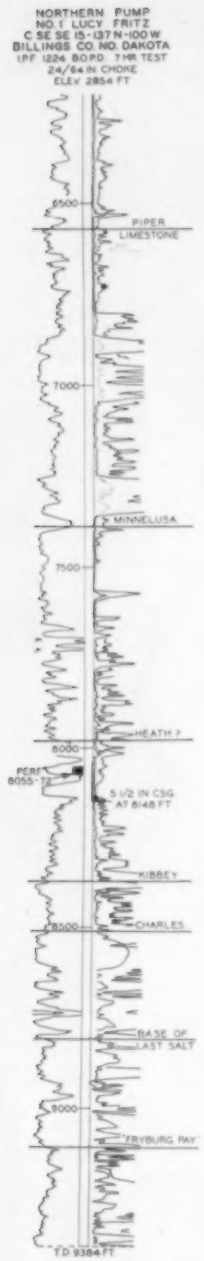
Ruegsegger . . . The second well in the area was drilling at 6,400 ft. on March 1. This 9,500-ft. well is 2 miles northeast of the 1 Tange and 3 miles northeast of 1 Loucks.

Rocky Ridge

Northern Pump Co.'s 1 Fritz-Heath sand oil discovery in Billings County, North Dakota, will certainly be one of the exploratory highlights in the state for 1957.

. . . The 1 Fritz was completed flowing 1,224 bbl. of oil per day from the Heath-Upper Mississippian sand at 8,055-72 ft.

. . . The Rocky Ridge field discov-



THIS HEATH DISCOVERY boosts hopes for this pay prospect in the Williston basin . . . The Rocky Ridge field opener is a step toward increased exploration in southwestern North Dakota.

"There are genuine signs of a definite pickup in exploratory and development activity throughout the vast Williston country on both sides of the border."

ery well is the best Heath producer in the basin to date.

. . . Nearest Heath sand production is 12½ miles north at Fryburg field. Heath production in the basin has been disappointing, but the big success at Rocky Ridge may change the outlook for this sand in Williston.

. . . Rocky Ridge is located in a sparsely touched wildcat country in the southwestern part of North Dakota. It is the southernmost producing area in the state. Wildcat drilling should pick up in Stark, Slope, Billings, and Golden Valley counties.

Sun Oil Co. is drilling below 3,690 ft. at the first confirmation try in the new field at 1 E. A. Smith. Success at this well will swing wide the partially opened door to production in this portion of North Dakota.

Other Williston Scores

There are genuine signs of a definite pickup in exploratory and development activity throughout the vast Williston country on both sides of the border.

In Saskatchewan . . . The big Mississippi push in southeastern Saskatchewan continues quietly but successfully. Last year this portion of the basin commanded drilling in the entire region. Rigs were in record numbers throughout the year, tapping new Mission Canyon fields by the dozen. This Mississippian march continues unabated, although not quite as spectacularly as in 1956.

In Northeast Williston . . . Exploratory drilling is seeing some scattered success once again on the northeastern rim of the basin in Bottineau County. Two fields of importance, Haas and Leach, have been opened this year. Leach field is a Spearfish-Triassic producer at 3,425-33 ft. Haas produces from the Nesson-Mississippian at 5,846-56 ft.

New producing county . . . North Dakota's Ward County is the newest addition to the state's producing areas.

Late in February Hanlon Drilling Co. and L. J. Williamson's 1 Knudtson, 40 miles east of Nesson anticline fields, swabbed 100 bbl. of oil in 7 hours from the Mission Canyon at 6,734-95 ft. At month's end the well was waiting for pumping equipment.

This Ward County opener is in rank wildcat country. Very little drilling has taken place in this section of North Dakota. Although the well's potential isn't a record, it points to the seemingly forgotten potentialities of Ward, Renville, eastern Mountrail, and McHenry counties.

At Beaver Lodge . . . There is a definite trend in Williston toward new-pay and deep exploration. The most news-making example of this new trend is Amerada's deep hole at Beaver Lodge, the 1 Iverson-Nelson in Williams County.

A 16-hour test of Red River perforations at 12,810-46 ft. got 241 bbl. of condensate late in February. Recovery included 25 bbl. of water and 8,140 M.c.f. of gas. Amerada shut in the well. From even deeper perforations at 12,846-76 ft. the well flowed 5,531 M.c.f. of gas in 9 hours. Successful completion of this interesting wildcat in North Dakota's first field would give the basin its deepest production. The current record-holders are Sanish field in North Dakota and Brorson in Montana. The company has another pre-Cambrian well drilling below 6,500 ft. at Beaver Lodge.

What's Next

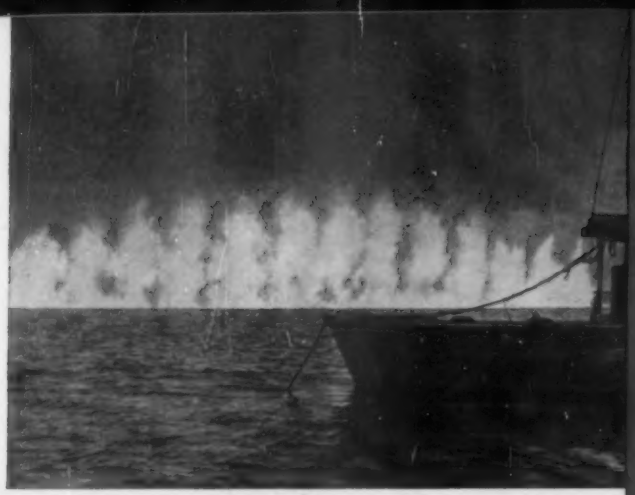
Williston has enjoyed a busy and successful drilling winter. The drilling pace will slow down for a few weeks with the coming of road bans and the inevitable spring thaws. But with the advent of warm, dry weather, look for real wildcat excitement in both eastern Montana and North Dakota.

The northeastern section of Montana, pushed on by Outlook's high promise, will see a flurry of wildcats this summer. This interest may extend across the border into a relatively undrilled area of extreme southern Saskatchewan, and into oil-barren western Divide County, North Dakota.

If Sun Oil Co. hits at the Rocky Ridge confirmation well, the wildcat tempo in southwestern North Dakota will increase.

It's a safe bet that Williston will rank just under the Paradox basin in Rocky Mountain exploratory interest this year. Outlook and Rocky Ridge have put new enthusiasm into Williston oil hunting.

"There is a definite trend in Williston toward new pay and deep exploration . . . with the advent of warm weather look for excitement in eastern Montana and North Dakota."



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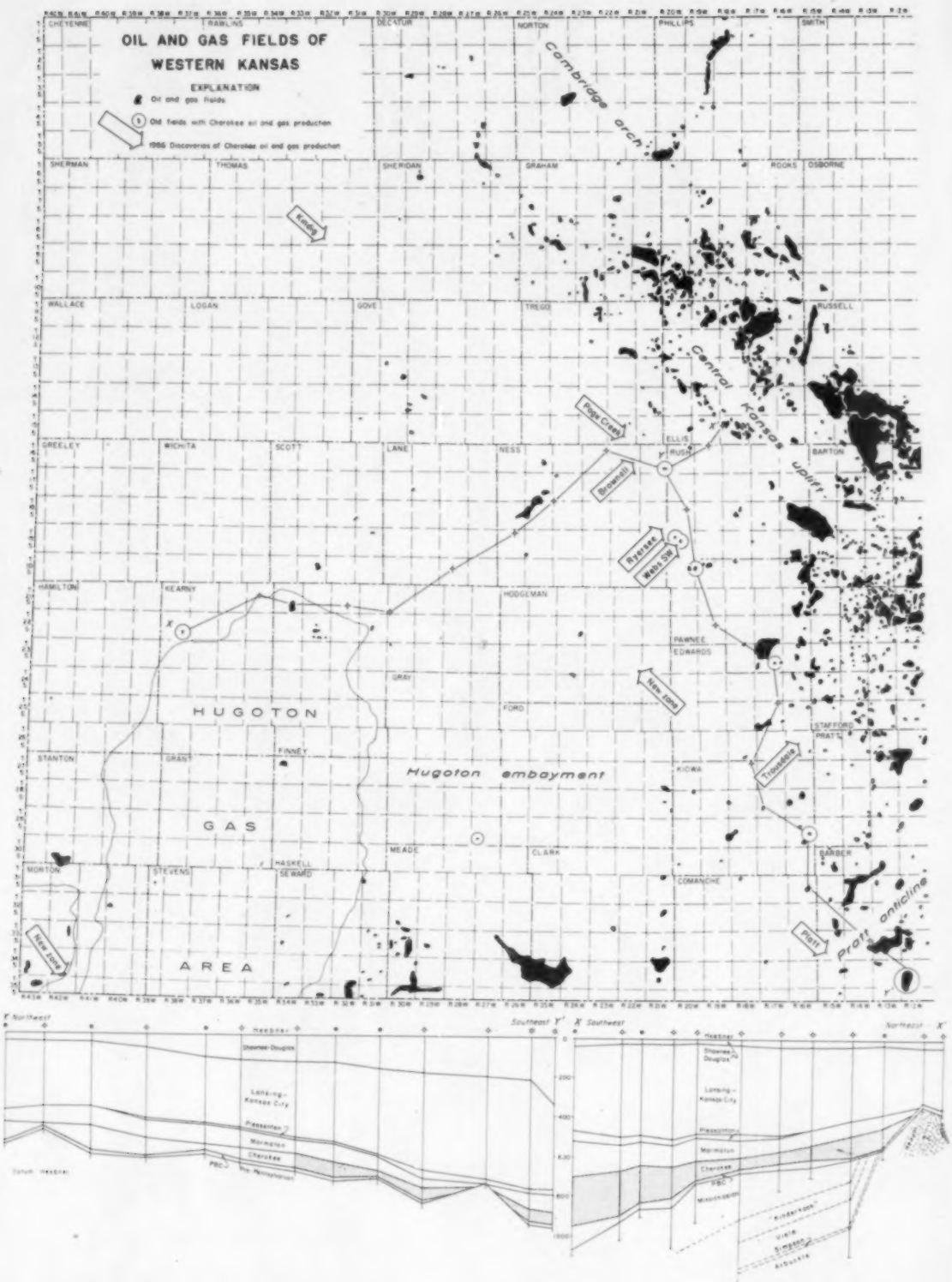
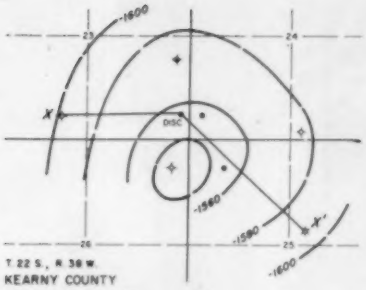
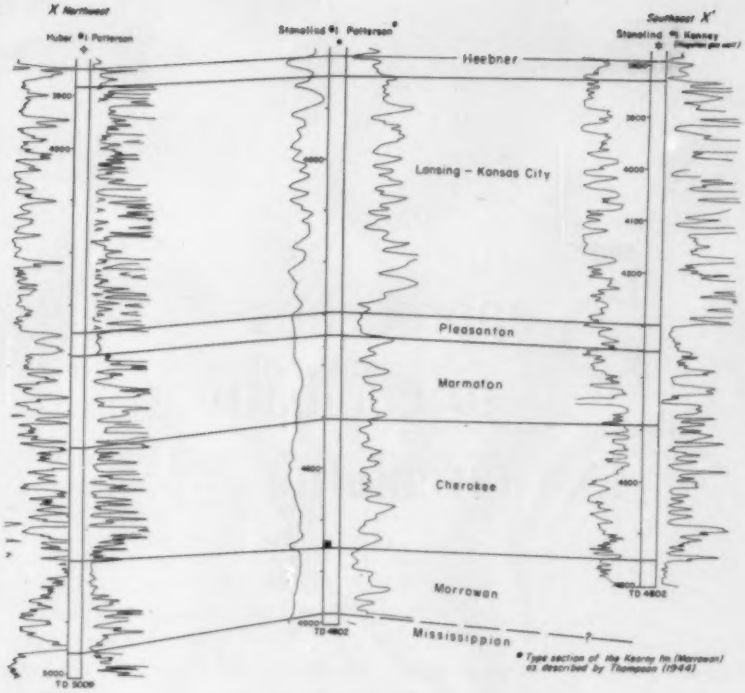


IMPORTANCE of Cherokee production on the west flank of the Central Kansas uplift is steadily increasing. Cherokee fields discovered in 1956 are shown by arrows. Fig. 1.





PATTERSON is the oldest Cherokee producing area in western Kansas. Both structure and stratigraphy are factors controlling production. Fig. 2.

"Trend Players" Look to Western Kansas Cherokee

- New discoveries can be expected from Cherokee rocks in western Kansas.
- The majority of the new discoveries will probably lie in a northwest-southeast, 25 to 50-mile wide trend along the western side of the Central Kansas uplift.
- Reservoirs will probably be in clastic rocks such as sandstones.
- Although traps are both structural and stratigraphic, Cherokee oil seemingly occurs on small anticlines with closures of 15 to 30 ft.

by Edwin D. Goebel and Daniel F. Merriam

ROCKS of Cherokee age have come into their own as a potential producer in 1957 in western Kansas. Present indications are that the Cherokee will become a major producing zone in the future. Operators are taking a second look at prospects in the light of the seven new field discoveries and two new zone discoveries during the first 9 months of 1956.

This year's activity exceeds by far the previous pace of Cherokee discoveries. The new oil fields include Platt in Barber County, Trousdale in Edwards County, Brownell and Ryerse in Ness County, Webs Southwest in Rush County, Kindig in Thomas County, and Page Creek in Trego County. The new zones in old fields include Cherokee gas in Taloga of Morton County, and oil in Saw Log Creek of Hodgeman County (see Fig. 1).

Authors are geologists with the State Geological Survey of Kansas. Publication of this article authorized by the director of the State Geological Survey of Kansas.

Before 1954, production from Cherokee rocks in western Kansas was limited to a few isolated fields, such as Patterson in Kearny County. During 1954, Shiley and Shiley East fields of Pawnee County were named as Cherokee reservoirs. Later, in 1955, other fields designated as having Cherokee production were: Carpenter West of Pawnee County, Davenport of Ness County, Hardtner of Barber County, and Soldier Creek of Kiowa County (Goebel and others, 1956). The "trend players" could even then observe, from the alignment of these fields, the beginning of a northwest-southeast trend.

Trend play . . . Distribution of the listed Cherokee fields, including the 1956 discoveries (Fig. 1), clearly shows that they fall within a definite northwest - southeast, 25 to 50-mile-wide trend along the western side of the Central Kansas uplift. The Garfield of Pawnee County, which was abandoned and then revived in 1953 (Ver Wiebe and others, 1954, page 111), lies on this trend. The producing zone is designated the Pennsylvanian-Mississippian contact; however, it may be that some of the production from this major oil reservoir is

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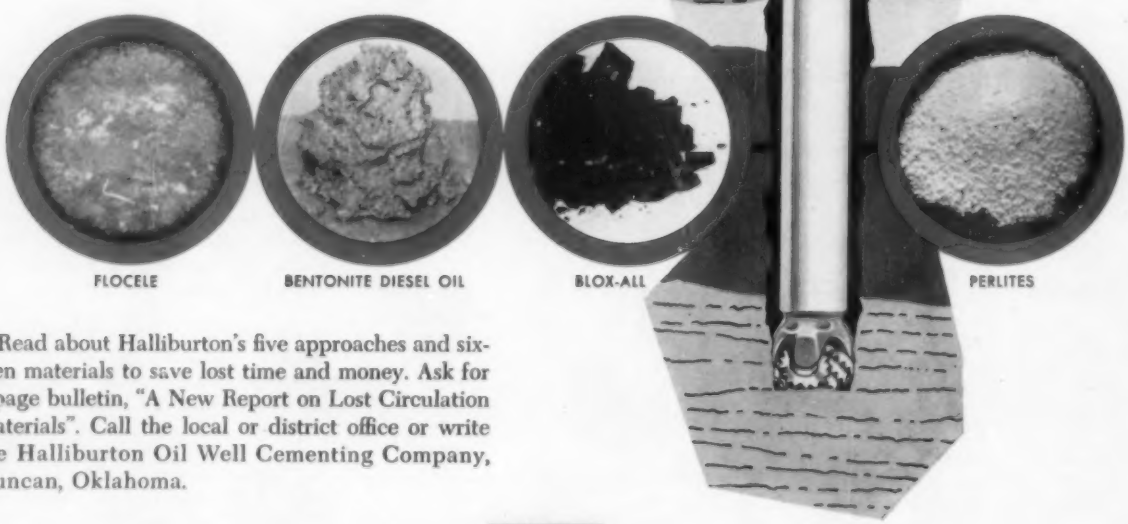

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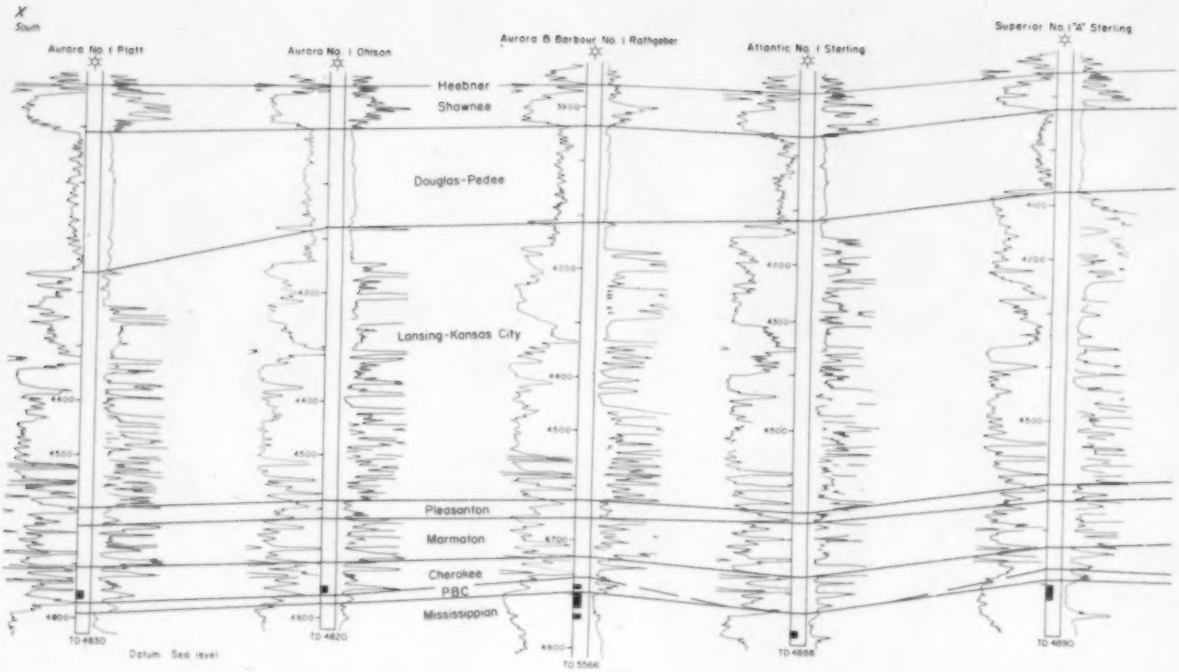
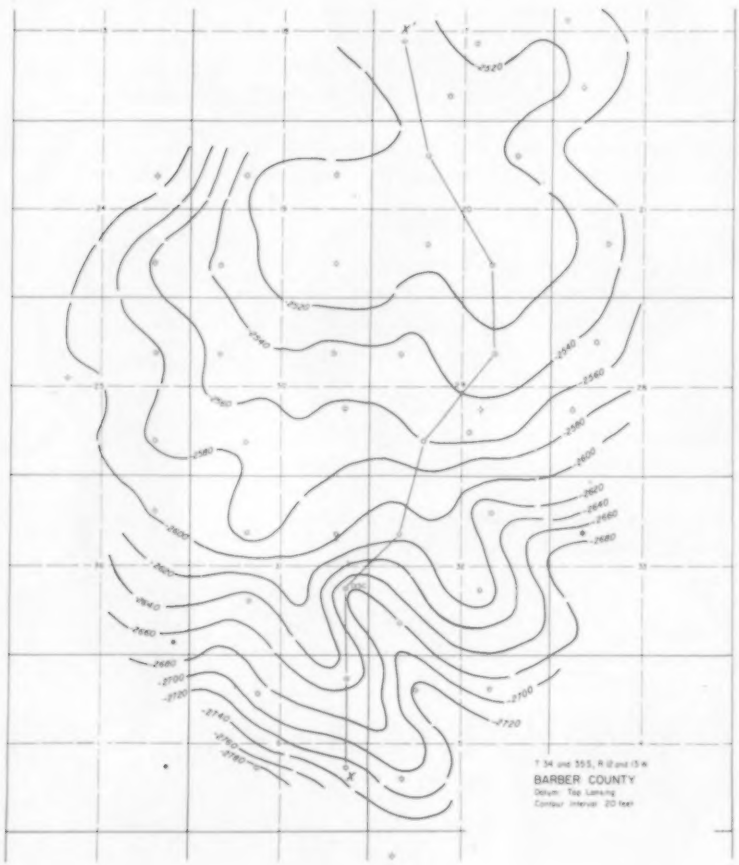


BOTH MISSISSIPPIAN AND CHEROKEE gas production occur at Hardtner. Most of the Cherokee wells lie in the southern part of the field. Fig. 3.



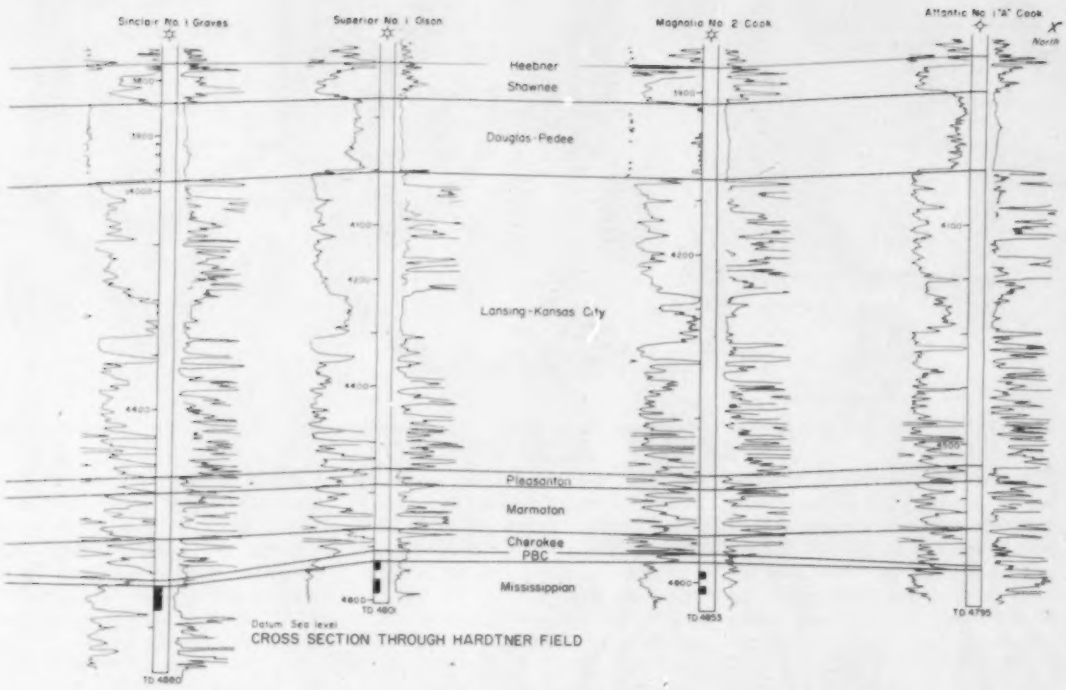
from strata of Cherokee age. Also, many other producing areas now designated as Pennsylvanian basal conglomerate, Pennsylvanian basal sand, Pennsylvanian - Mississippian contact, Burgess sandstone, etc., are probably Cherokee in age.

Previous to 1954, production from the Cherokee rocks in western Kansas was insignificant compared to other pay zones. But with development of the many new fields, rocks of Cherokee age should be carefully checked before abandoning any test. Undoubtedly, operators will now also review previous drilling along this Cherokee trend. Such a reexamination could result in discovery of additional Cherokee production.

Production from the Cherokee fields in western Kansas is shown in Table 1. A total of only 687,973 bbl. of oil was produced prior to 1956. Production during the first 9 months of 1956 from these fields amounted to almost 50 per cent of the cumulative total. The average initial potential of all the 1956 Cherokee oil discovery wells is 159 bbl. of oil per day, a very significant figure.

Geologic Setting

Cherokee oil and gas occurs in traps of varied types. Preliminary geological investigations of the incompletely drilled producing areas indicate that some fields are located on small anticlinal structures. Closures range from 15 to 30 ft. on the top of the Lansing-Kansas City in new fields located in



CROSS SECTION THROUGH HARDTNER FIELD

the Cherokee trend. Some of the fields produce from stratigraphic traps where porosity and permeability are all-important factors. Reservoirs in most instances appear to be sandstones.

A northeast-southwest cross-section from Ellis County to Kearny County (X-X', Fig. 1) shows the stratigraphic relation of the Cherokee rocks to older and younger units. The Central Kansas uplift is evident on the northeast, and Cherokee rocks are shown to abut against this positive uparched element. Toward the southwest away from the uplift, the Cherokee thickens into the Hugoton embayment. Near the uplift the Cherokee is composed mostly of clastic material, whereas farther southwestward in the embayment it consists mostly of limestone and black shale. Basal sands are present locally and usually can be differentiated from the Pennsylvanian basal conglomerate.

In western Kansas, Cherokee strata overlie rocks ranging in age from pre-Cambrian to Atokan. The cross-section shows that the lower Pennsylvanian sediments overstep older rocks progressively toward the uplift. The Marmaton group, which consists mostly of limestone and shale, conformably overlies the Cherokee.

A northwest-southeast cross-section from Rush County to Barber County (Y-Y', Fig. 1) roughly parallels the trend of the Central Kansas uplift. Near the southeastern end of the section, the Pratt anticline is evident, as the Cherokee does not extend across it. Other structural highs are revealed by a thin Cherokee section over their crests.

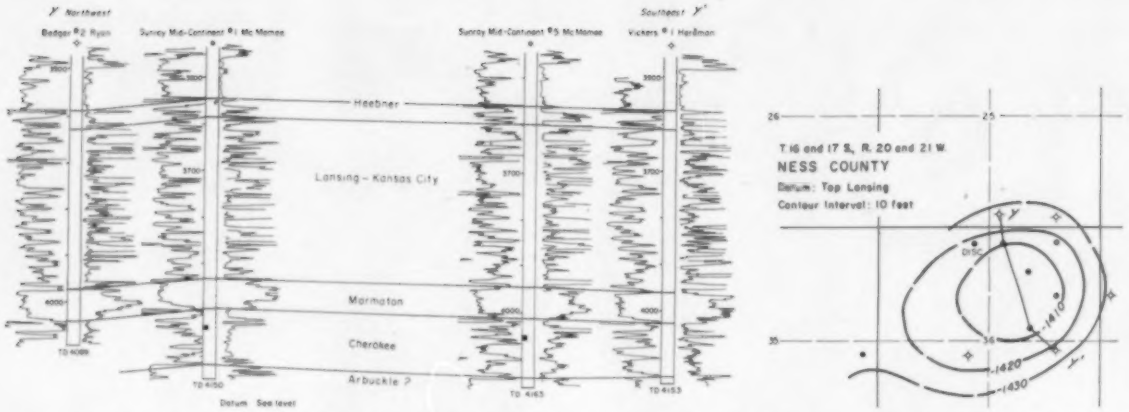
By the beginning of Cherokee time, the major structural features of western Kansas, such as the Hugoton embayment, Pratt anticline, Central Kansas uplift, and Cambridge arch, had developed, and the structural pattern was established.

The Hugoton embayment, during Morrowan and Atokan times, continued to be downwarped and to receive sediments from the area of the Central Kansas uplift. The end of

TABLE 1—CHEROKEE OIL AND GAS PRODUCTION FROM WESTERN KANSAS FIELDS

Field name—	Year discovered	Initial potential discovery well (B.O.P.D.)	Oil production through Sept. 1956	Oil production previous to Jan. 1, 1956
Barber County:				
Hardtner	1955	*18,955,000	Undifferentiated	None
Platt	1956	160	No report	None
Edwards County:				
Trousdale	1956	232	4,222	None
Hodgeman County:				
Saw Log Creek	1956	83	5,708	None
Kearny County:				
Patterson	1941	3,964	515,000	485,519
Kiowa County:				
Soldier Creek	1955	117	11,306	6,046
Morton County:				
Taloga	1956	*15,800,000	No report	None
Ness County:				
Brownell	1956	11	174	None
Davenport	1955	144	60,579	6,266
Ryerse	1956	197	3,074	None
Pawnee County:				
Carpenter West	1955	25	573	573
Shiley	1954	506	99,247	68,743
Shiley East	1954	91	103,117	59,140
Rush County:				
Webs	1954	3,000	120,921	61,686
Webs Northwest	1955	36	2,889	None
Webs Southwest	1956	59	1,342	None
Thomas County:				
Kindig	1956	401	5,288	None
Trego County:				
Page Creek	1956	128	2,158	None
Total			935,598	687,973

*Thousand cubic feet.



DAVENPORT was discovered by Manhart, Millison, and Beebe in1955. Here Cherokee rocks overlie the Arbuckle limestone. Fig. 4.

Atokan time was marked by a withdrawal of the sea, and erosion took place before the readvance of the sea in Desmoinesian time. By the end of Desmoinesian time the basin was almost filled. Missourian sediments completed the filling and extended across the Cambridge arch and the Central Kansas uplift (Merriam, 1955).

Differential downwarping and uparching persisted to the end of the Paleozoic era; major structural development occurred at the conclusion of Permian time. Later movements during the Mesozoic and Tertiary only modified the regional structural features. These post-Cherokee structural movements certainly affected the movement and accumulation of oil in Cherokee rocks.

Cherokee Fields

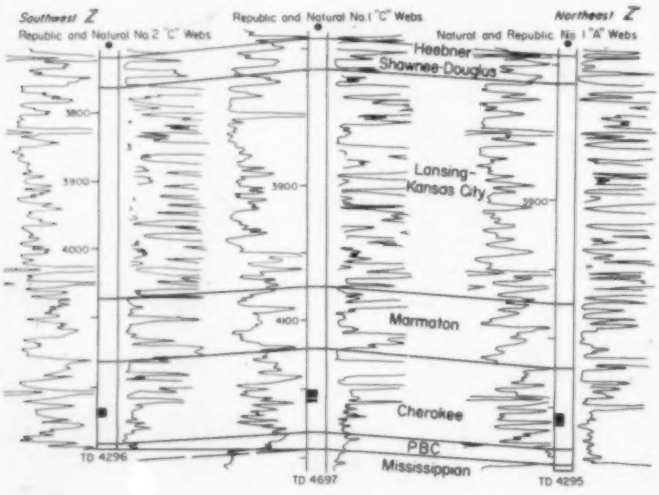
Patterson . . . Patterson field, discovered in 1941 by Stanolind Oil & Gas Co. (now Pan American Petroleum Corp.) in its No. 1 test on the Patterson lease in 23-22s-38w, has the distinction of having the oldest known Cherokee production in western Kansas. The producing zone, given the name "Patterson" (basal Cherokee), is found between depths of 4,740-52 ft. Initial potential of the discovery well was rated at 3,964 bbl. of 34°-gravity oil per day.

In 1944, when Thompson named the Kearny formation (type Morrowan) in Kansas from the discovery well of Patterson field, a total of only three producers had been completed. At the beginning of 1956, Patterson was the only oil field in Kearny County and had produced over 485,000 bbl. of oil (Table 1).

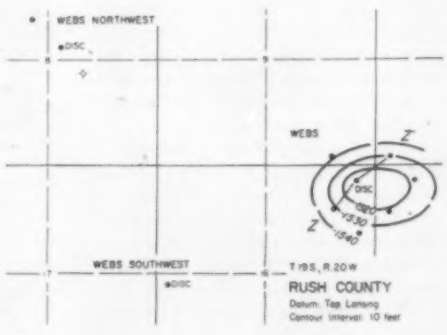
Patterson field, contoured on top of the Mississippian, shows a structure with about 20 ft. of closure (Fig. 2). However, the producing area lies off to the northeast of the high; seemingly, factors other than structure are important. The electric-log cross-section through the field shows "Patterson" sand in contact with Morrowan rocks.

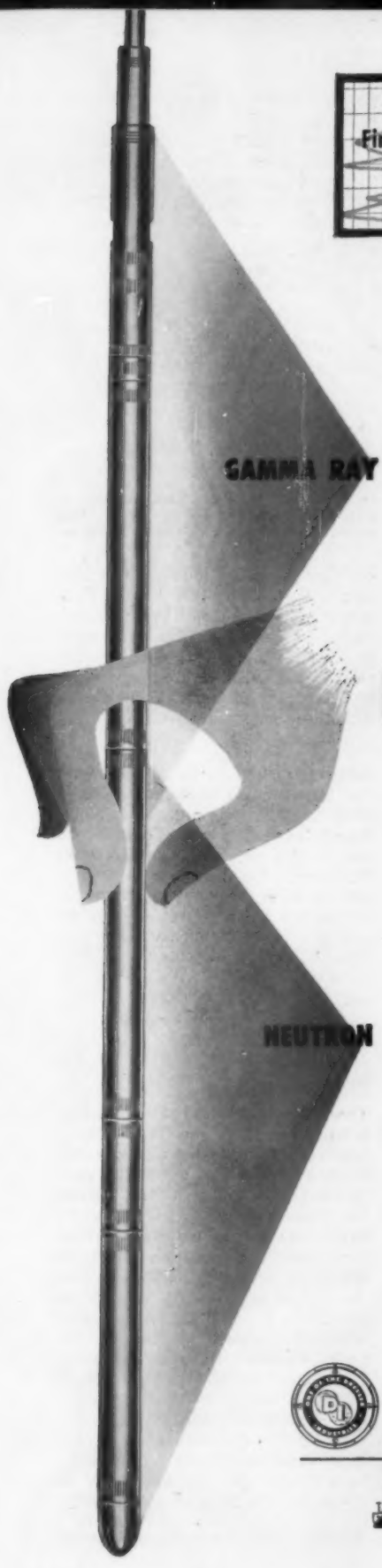
Hardtner . . . Hardtner gas field (Fig. 3) of Barber County, located just southeast of the famous Medicine Lodge field, was brought in by Aurora Gasoline Co. and Barbour Drilling Co. 1 Rathgeber well in 31-34s-12w, in October 1954 (Wible, 1956). The Mississippian was named as the producing horizon between depths of 4,782-88 ft. and assigned an initial potential of 13.5 M.M.c.f.d. The Cherokee rocks were found to be productive in the Barbara Oil Co. and Aurora Gasoline Co. 1 Bank Unit in 5-35s-12w. An open-flow test with perforations from 4,791-99 ft. recovered more than 18.9 M.M.c.f. of gas. Several adjacent wells also were found to have Cherokee gas. Total undifferentiated production from 18 Mississippian and Cherokee wells during 1955 came to more than 1,943 M.M.c.f. The field now covers more than 3,600 acres, with spacing on a quarter-section basis.

Here, the Cherokee rocks overlie the Pennsylvanian basal conglomerate, but in places the latter is missing and Cherokee is in contact with the Mississippian strata (Fig. 3). Most of the Cherokee gas wells are in the southern portion of the field as shown by the cross-section. The structure of the



THREE FIELDS produce in the Webs area. Pay zone is a sandy zone in the lower Pennsylvanian section just above the basal conglomerate. Fig. 5.





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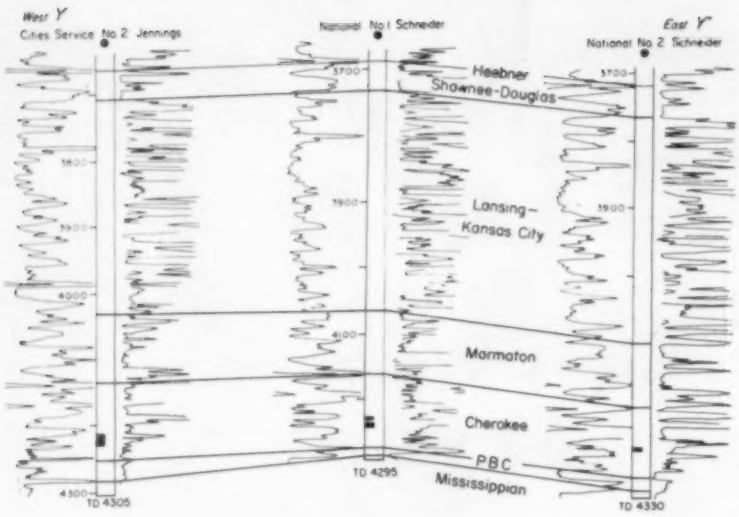

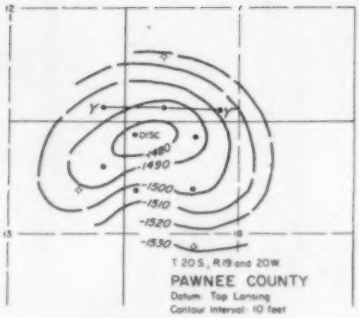

SHILEY EAST is a small anticline that is fairly well delineated by dry holes. The producing area covers only 160 acres. Fig. 6.

field, as reflected by a structure contour map on the Lansing-Kansas City, is that of a southward plunging nose. Since no closure is evident, stratigraphic factors are assumed to play an important part in the entrapment of the gas.

Davenport . . . Ness County's Davenport (Cherokee) field was discovered with the completion of the Manhart, Millison, & Beebe 1 Davenport well in 36-16s-21w, in July 1955. Production of 144 bbl. of 41°-gravity oil per day through perforations between 4,045-47 ft. was announced. The Arbuckle was topped at 4,138 ft. before the well was plugged back to the Cherokee pay. An offset well to the discovery well, the Sunray Mid-Continent 1 McMamee in the same section had a maximum initial potential of 3,000 bbl. of oil per day. The two wells reported prorated production of 6,266 bbl. of oil during 1955. Five additional Cherokee producers have been completed in the field in 1956. Cumulative production through September 1956 amounts to about 60,500 bbl.

The Cherokee rocks in Davenport field overlie the Arbuckle as shown by the cross-section in Fig. 4. The pay zone is in the upper portion of the Cherokee. A contour map on the Lansing-Kansas City shows the structure of the field to be an east-west elongated anticline with about 20 ft. of closure. There is good agreement between producing area and structure.

Webs . . . The three Webs fields, Webs, Webs Northwest, and Webs Southwest in 19s-20w, Rush County, produce from a sandy zone in basal Pennsylvanian rocks just above the conglomerate zone. The Webs field discovery well, drilled in 1954 by Republic Natural Gas Co., had an initial potential of 3,000 bbl. of oil per day from perforations between 4,202-12 ft. Webbs Northwest field was brought in by the same company on the Sehl lease in Section 8, with an initial potential of 36 bbl. of oil per day. Webs Southwest field, another Cherokee producer, was discovered during July 1956, when the Natural Gas & Oil Corp. completed its 1 Williams "B" in Section 16, about 1 mile southwest from the discovery well of Webs field. Initial production of 59 bbl. of oil per day from depths of 4,302-04 ft. was reported. Cumulative production from the Cherokee wells in the three Webs fields amounts to more than 125,000 bbl. of oil.

An electric-log cross-section across Webs field (Fig. 5) shows the Cherokee rocks overlying the Pennsylvanian basal conglomerate. There is about 15 ft. of structural closure on Webs field as shown on the Lansing-Kansas City horizon. The anticline is elongated in an east-west direction. The dry hole in NE NW SE Section 8, just southeast of Webs Northwest field, was completed in March 1956. Cherokee was called at 4,255 ft., and perforations were made from 4,254-60 ft. with no success.

Shiley East . . . Shiley East field of Pawnee County was designated as Cherokee production upon completion of the National Cooperative Refinery Association 1 Eckert well in 18-20s-19w, in late 1954. Initial production amounted to 91 bbl. of 38°-gravity oil from perforations between 4,223-25-ft. depth. Through September 1956, eight Cherokee wells in the field had produced more than 103,000 bbl. of oi. Field area amounts to a little less than 160 acres.

The structure on the Lansing-Kansas City shows an anticline with closure of about 25 ft. (Fig. 6). The field is fairly well delineated by dry holes, except on the western side. The locations of perforation are noted on the electric - log cross - section across the northern part of the field and seem to indicate an oil-saturated sandy reservoir rock.

Soldier Creek . . . In March 1955, the Mississippian rocks were designated as oil-bearing in the new Soldier Creek field of Kiowa County; and then in May 1955, Graham-Messman-Rinehart Oil Co. brought in the Cherokee producer, the 1 Piester "A" in 23-29s-16w. Oil was recovered at the rate of 117 bbl. per day from perforations between 4,599-4,603 ft. Production of 6,046 bbl. of Cherokee oil, and approximately 7,300 bbl. of Mississippian oil was reported for 1955. Cumulative Cherokee production through September 1956 is 11,306 bbl. of oil.

Trousdale . . . Edwards County added a Cherokee field, the Trousdale, in May 1956, with the completion of the Aurora Gasoline Co. 1 Schultz well in 21-26s-16w. The top of the Cherokee was called at 4,462 ft. in the new field. Four feet of pay with perforations between 4,486-90 ft. flowed 232 bbl. of oil per day. The Mississippian was topped at 4,510 ft., the Simpson at 4,787 ft., and the Arbuckle at 4,862 ft. National Cooperative Refining Association's offset well to the south was carried as a dry hole on the scout reports when completed in August. Muir & Giles 1 Giles in Section 28, ½ mile south of the Trousdale discovery well, found 6.5 M.M.c.f. of gas per day from the Pennsylvanian basal conglomerate.

Kindig . . . Veeder Supply & Develop-

ment Co. and others completed Kindig field, an exciting new development, in Thomas County in June 1956. Their new Cherokee well on the Kindig lease in 30-8s-32w, found 401 bbl. of oil per day from depths of 4,608-12 ft. The top of the Cherokee was called at 4,557 ft. from an elevation of 3,132 ft. The test was drilled into Mississippian rocks but plugged back to the Cherokee pay. Production of more than 5,000 bbl. has been recorded thus far from Kindig field (Table 1). The field is located about 6 miles north of Thomas County's only other oil field, the Mingo, discovered in 1952 as a Mississippian pool but redesignated Marmaton in 1954.

Platt . . . Southwestern Barber County came into the Cherokee oil picture with Republic Natural Gas Co. 1 Platt well in 28-33s-15w, completed in October 1956. The Cherokee rocks in Platt field were topped at 4,791 ft. Perforations in the top 4 ft. of Cherokee flowed 160 bbl. of oil per day. Simpson rocks were encountered at 5,266 ft., and Arbuckle rocks were topped at 5,408 ft. before the well was plugged back to the Cherokee pay.

Page Creek . . . Cherokee production was found by K. & E. Drilling Co. et al. in the Tipton estate well in 28-15s-22w, in Trego County early in September 1956. The Cherokee sand in this new field, the Page Creek, from depths of 4,260-65 ft. yielded 128 bbl. of oil per day after perforations.

Brownell . . . Two fields, Brownell and Ryersee, were brought in along the Cherokee trend in Ness County in June 1956. The Welch & Olsson Drilling Co. 1 Walker well, in 23-16s-22w, was gaged at 11 bbl. of oil per day from perforations of 4,341-45 ft. No shows were reported from the Mississippian rocks penetrated at 4,380 ft.

Ryersee . . . Ryersee field was brought in for 197 bbl. of oil per day from the Cherokee sand picked at 4,100 ft. Stickle Drilling Co. et al. drilled the discovery well on the Ryersee lease in 35-18s-21w. Four zones were perforated between depths of 4,100 and 4,122 ft.

Saw Log Creek . . . Saw Log Creek field of Hodgeman County, named as Marmaton production in 1953, added a Cherokee oil zone with the completion of the Atlantic Refining Co. 2 Hall well in 36-23s-22w, in April 1956. The operators recovered 83 bbl. of oil per day from perforations between 4,478-86 ft. Top of the Cherokee was called at 4,449 ft., and the Mississippian was penetrated before plugging back. The well also was completed in a Marmaton pay zone.

Taloga (gas) . . . The discovery well of the Taloga Morrowan gas field in Morton County was reworked for additional gas from Cherokee rocks between depths of 3,894-3,902 ft. Top of the Cherokee was recorded by Panhandle Eastern Pipe Line Co. in its 1-34 Land Bank well in 34-34s-42w at 3,877 ft.

Inactive fields . . . Bay Petroleum Corp. 1 Fisher well in 26-23s-17w (Pawnee County), found Cherokee oil in April 1955, when 25 bbl. per day was recovered from 4,240-44 ft. Cumulative production for 1955 amounted to 573 bbl.; however, this field, the Carpenter West, is now probably plugged and abandoned.

Gray County's Jumbo field was named in 1953 as Cherokee production, but later the discovery well was reworked and declared dry and abandoned.

One well in Nunn field in Finney County was perforated in the Cherokee, but production data are not available.

Editor's note . . . After this paper was written, it was called to the attention of the authors that Kutina field had been redesignated Cherokee production. This field in Trego County was named as Mississippian production in 1953. No production was reported during that year nor 1954. In 1955, 4,597 bbl. of oil was reported produced from Cherokee rocks between 4,220 and 4,225 ft. in the Atlantic Refining Co. 1 Kutina well in 20-15s-21w. An initial potential of 180 bbl. of oil per day was given this newly designated discovery well.

In December 1956, Sunray Mid-Continent Oil Co. completed the discovery well of Trousdale South field in 33-26s-16w. An initial potential of 5,304,000 cu. ft. of gas per day was reported from the Cherokee rocks from depths of 4,472 to 4,477 ft.

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Seismic data are easier to understand . . . . . through use of data-processing equipment

How to Make Seismic Data Understood

An old problem appears to be on road to solution

by K. E. Burg

NEW methods in handling seismic data are now giving promise of solving a problem that has faced the geophysical exploration industry since its inception. This problem has been one of presenting seismic information in an easily grasped form. This form must have full meaning for the geologist who develops a subsurface picture of his prospects. This form must also substantiate the geological interpretation and must have meaning for the oil-company management who base exploration decisions on understanding of geophysical-geological data.

The new methods of presenting seismic results are those of seismic data processing; these methods are made possible largely by the characteristics of data storage and data reproducibility contributed by magnetic recording of seismic data.

For many years the geophysicist has worked with individual paper seismograms. On them he has picked individual reflections. These reflections give him points to be plotted, one by one, as a seismic cross-section. The sections were shown in time measurements or converted into depth measurements. Progress and final maps were made from data available on the plotted cross-section.

This form of presenting seismic data leaves much to be desired. First, the geophysicist is limited in the amount of information he is able to transfer to his cross section. He must select the most significant elements from the multiplicity of data available on the original seismogram; his judgment of significance is influenced by the geological problem under immediate consideration. Second, in making his geological interpretation and in reaching a decision the geologist has available only those data points selected by the geophysicist.

When the geologist and the geophysicist work closely together on a current problem, so that each understands the requirements of the other, this method of presenting seismic data has been considered adequate. But in many instances, perhaps in most instances, decisions on a prospect are made long after completion of the original seismic work. Often the decisions are made by someone not familiar with the whole course of the original work. In evaluating the available seismic information, those who make these later decisions have two courses open to them: (1) They must depend only on the judgment of the geophysicist and the geologist who first worked with the data; or (2) they must undertake a time-consuming and costly review of the original seismograph records.

Thus, the value of geophysical work is directly related to the ability of the geophysicist to present significant bits of information in a form ready for use at a later date.

Requirements . . . To reach standards of maximum effectiveness and usefulness, seismic data should meet at least two sets of requirements, those of the geologist as well as those of the geophysicist.

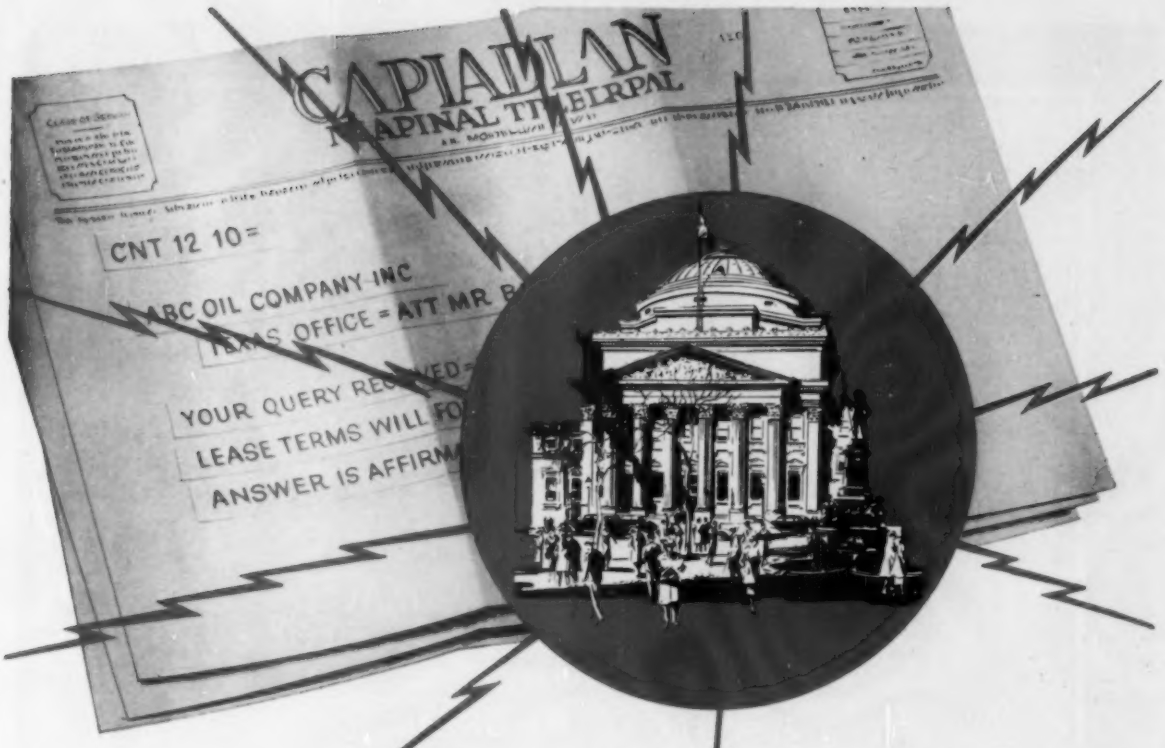
The geological requirements of seismic data should include:

- Presentation in a form that can be readily related to known geology.
- Presentation in a form that is readily reproducible.
- Presentation in a form that preserves original data and is quickly available.

To arrive at these geological requirements, seismic data should:

- Have maximum accuracy, with as many distortions as possible removed.
- Have maximum detail, with all original data preserved or enhanced.
- Be in true space position, in either time or depth, migrated, and with horizontal and vertical scales equal if desired.
- Require a minimum of routine computations and be easy to work with.
- Lend itself readily to alternate interpretation or presentation.

Seismic data processing equipment and techniques now available go far toward presenting geophysical information in a form that meets all these requirements. During the past year, the term "record section" has come to take on new meaning in the geophysical industry. And more and more companies are beginning to require that their seismic work be done in such a manner that the recorded data



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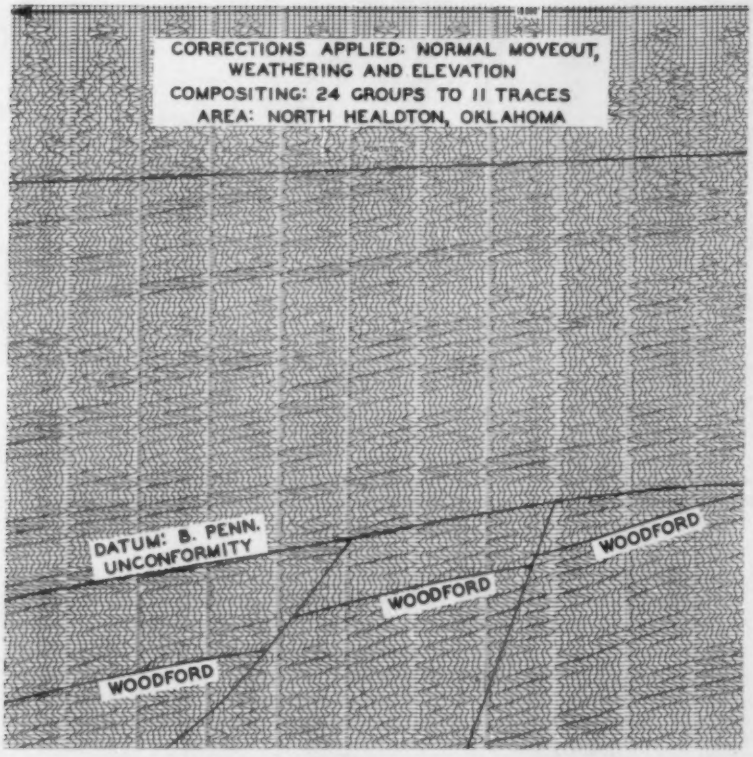

Fig. 1—This corrected time section, from data magnetically recorded in Oklahoma, shows how accuracy of information is maintained throughout the correction process. Such sections are suitable as direct work sheets, can be easily reproduced.

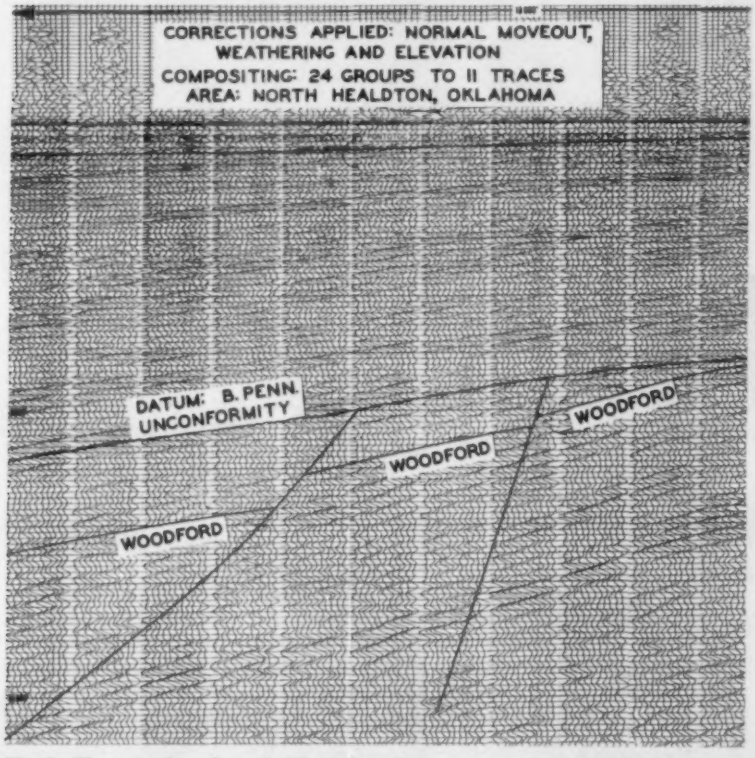

Fig. 2—The same data shown in Fig. 1 have been processed through a time-depth conversion camera. All information is expressed in terms of depth instead of seismic time. Well logs may be reduced to matching scale and superimposed for direct relationship to subsurface.

can be processed for incorporation into corrected record sections.

Corrected record sections . . . A direct result of the advent of magnetic recording is the corrected record section; in these sections certain distortions which inherently enter into the original recordings are removed upon playback of the record through time-shifting equipment. Corrections are now being applied for changes in surface elevation and for changes in the depth of weathering over the extent of a seismometer spread. These are the so-called "static" corrections. Additional "dynamic" time shifts are being applied for spread geometry; these correct seismometer group positions to a common shot-to seismometer distance over the entire depth of the record. Further shifts in time can be applied to magnetically recorded data to refer reflected energy to a selected plane or to a selected reflection.

Application of a velocity function upon playback of data can also be applied during the correction process; thus the resulting seismogram is expressed in terms of depth instead of time.

Additionally, required filtering can be introduced. Various patterns of compositing can be applied to bring horizontal and vertical section scales into equal relationship.

The result is a cross-section of seismic information that is more nearly directly related to the actual geology of the subsurface.

Of equal importance, the result is a continuous section of individual rec-

THE AUTHOR

Kenneth E. Burg is vice president of Geophysical Service Inc., Dallas; he is in charge of the company's geophysical engineering department, which embraces the activities of geophysical research and geophysical applications and furnishes technical services to field parties operating throughout the entire organization.

In recent months he has given an illustrated talk on seismic data processing, "Preparation of Seismic Data for Geological Interpretation," before a large number of geophysicists and geologists. The accompanying article is based on major points of this lecture.

Burg has been a member of the G.S.I. staff since 1930, when the company was formed, except for the years 1942-46 when he was employed with Stanolind Oil & Gas Co., being placed in charge of geophysical operations for the company in 1944.

Mr. Burg is a member of the S.E.G., A.A.P.G., A.G.U., S.S.A., the Dallas Geophysical Society, and the Institute of Radio Engineers. He received the B. S. degree in electrical engineering from University of Texas in 1926.

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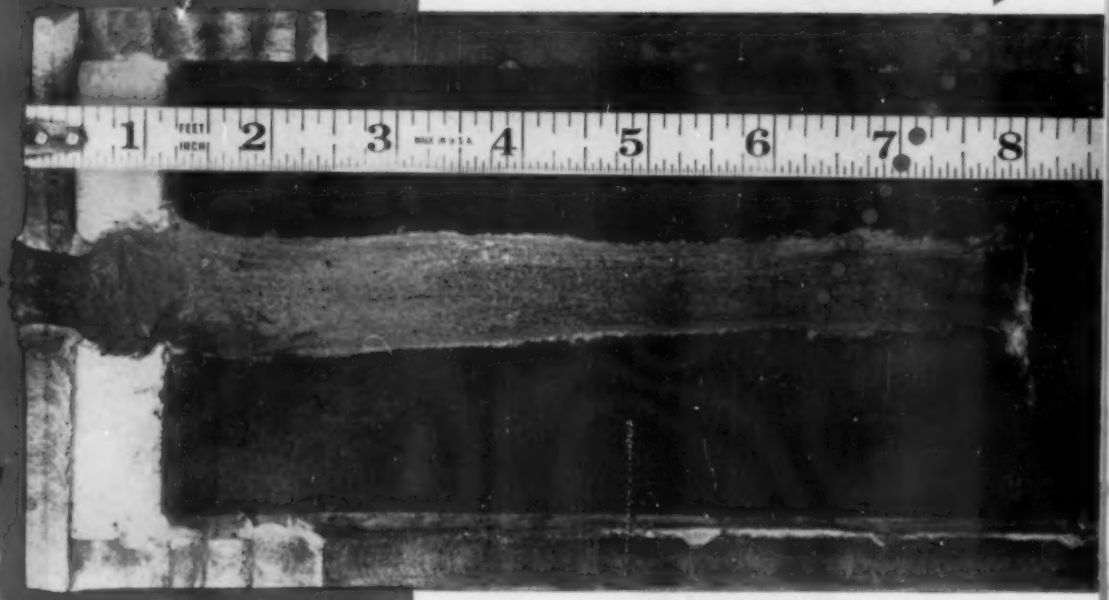

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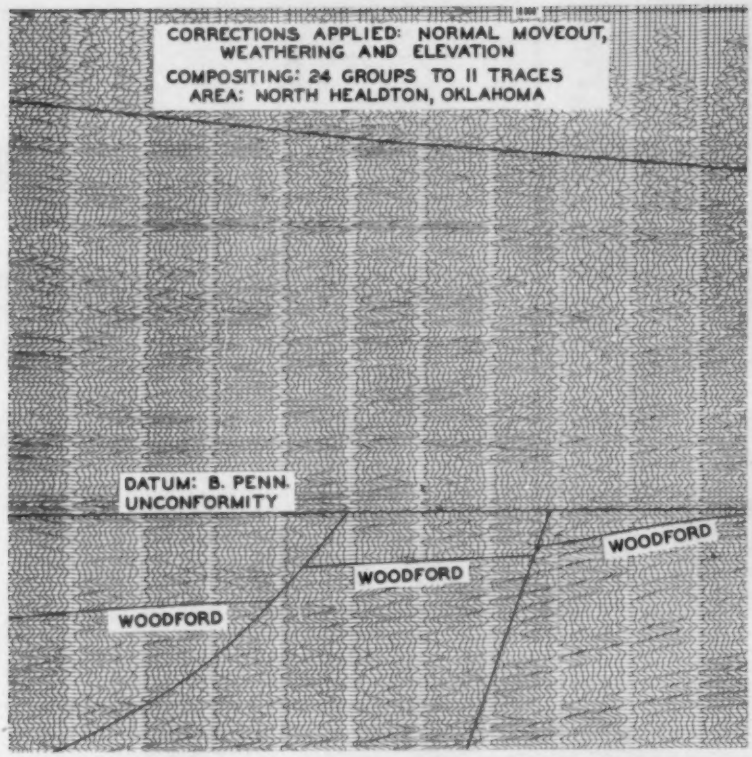


Fig. 3—In this time section, data have been corrected to an unconformity at the base of the Pennsylvanian. In effect, the correcting process has removed later sediments. This shows the subsurface as it would appear at the beginning of Pennsylvanian time.

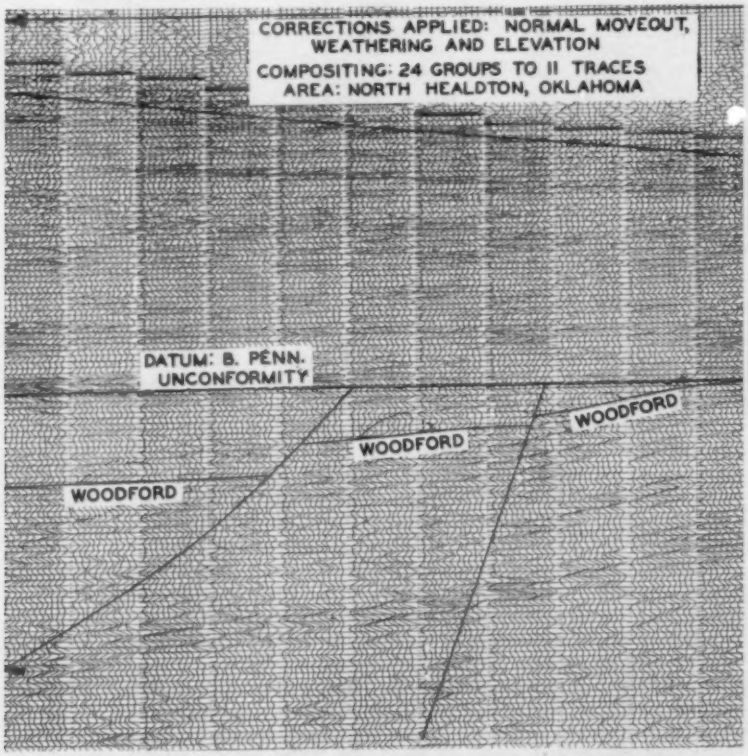


Fig. 4—As in Fig. 3, data are shown here corrected to the unconformity at the base of the Pennsylvanian, but are expressed in depth. Horizontal and vertical scales equal.

ords. These are matched either in time or in depth and preserve all of the original seismic data in highly accurate form. The seismic data are readily available to the geophysicist, the geologist, and to company management as interpretations and development decisions are made.

Preserving original data as they do, these corrected record sections can eliminate the laborious intermediate step of the plotted cross-section. They can also allow the direct application of subsurface information; for example, a well log may be reduced in scale to match the scale of the section. Additional geological data can be added as they become available. And the judgment behind each interpretation can be verified or discredited upon the basis of data that remain always available.

Record Sections Not New

Record sections themselves are not new. In various forms they have been considered since the introduction of the seismic method of exploration. Heretofore they have ranged from the suite of records spread out on the floor or on a table top to the cross-section plotting of elements of reflection events. Only recently, through the development of equipment that either electronically or mechanically accomplishes the required time shifting, has it become possible to produce the fully corrected record section. This section meets most of the basic geological and geophysical requirements of seismic data.

Today's record sections are no longer laboratory products. (See Figs. 1-4). With them many companies can get fuller use of their seismic information. On a regular production basis, they are being turned out today in two ways: (1) through the centralized data processing office; and (2) with complete processing equipment supplied the seismic party operating in the field. Both methods of producing corrected record sections appear to have their advantages. There is a large backlog of magnetically recorded seismic data. Handling this backlog undoubtedly will require a processing service that can be supplied only by centrally located equipment ready to handle such backlog on a job basis.

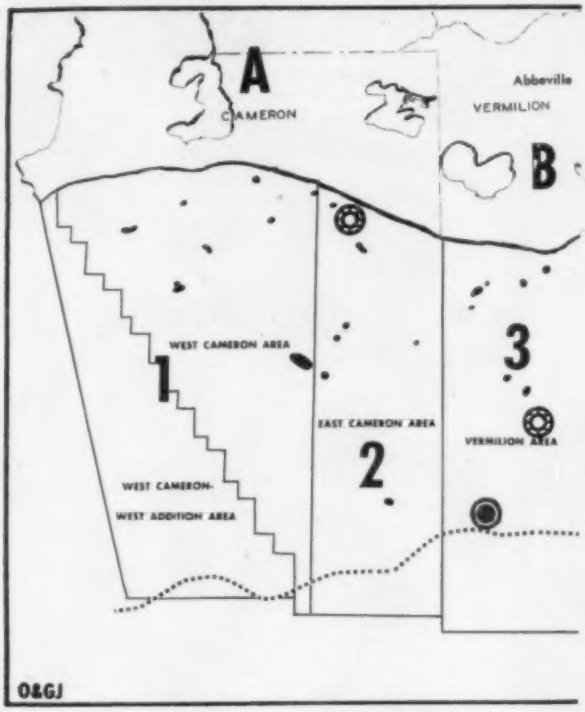
In any event, corrected record sections are doing much to solve the long-standing needs of the geophysicist and the geologist, and to promote their closer cooperation. It is perhaps too early to say how much oil has been found through interpretations based on record sections. But it is not at all too early to predict that the major portion of the oil found in the future will be located through their use. **End.**

THAT OFFSHORE BOOM

100 Fields Found, 58 Producing Oil

That's the score to date for Louisiana's Continental Shelf

by Neil Williams



LOUISIANA'S Continental Shelf has been pictured in the past as being a great province of vast undiscovered oil and gas reserves—one of the country's most promising frontiers for exploration.

In the few years since its potentialities began to be exploited, evidence has been revealed to remove any question that this is true.

This evidence is in the form of fields already proved or indicated to exist, and the great producible reserves established. The list of fields so far discovered totals more than 100; of these, 58 are productive of oil. The others so far have produced only gas or gas-condensate.

In view of the multiplicity of potential pay sands and the variety of reservoir conditions that exist in Gulf Coast fields, any field now productive only of gas or gas-condensate may be found productive of oil.

When market outlets become available, many of these gas reservoirs, which have had to be shut in, will prove to be as valuable as many of the presently known oil fields, if not more so.

It is significant that more than half of the known fields have been discovered within the past 2 years. Louisiana's first field in the Gulf of Mexico was discovered in 1938 at Creole, about 1½ miles off the coast of Cameron Parish at the western end of the state's shelf area. However, except for additional wells drilled at that field, there was no further offshore drilling until 1947.

A shallow oil discovery late in that year by Kerr-McGee Oil Industries, Inc., in Block 32, Ship Shoal area, about 12 miles off the coast of Terrebonne Parish, generally is credited with launching the present offshore play. Even then, no great drilling play was attempted. High costs of operating offshore, uncertainties, the need for planning and providing suitable facilities for a new type of work, and other complications made operators slow to venture into an active exploratory play. Also, as exploratory activity began to mount, it was interrupted periodically by legal questions arising in the state-federal dispute over ownership rights.

FIELD DENSITIES
PARISHES INSHORE

A

Cameron
Sq. miles 1,444
No. fields 40
Sq. miles per field . 36

B

Vermilion
Sq. miles 1,224
No. fields 22
Sq. miles per field . 56

C-D

Iberia and St. Mary
Sq. miles 1,193
No. fields 25
Sq. miles per field . 48

E-F

Terrebonne and Lafourche
Sq. miles 2,548
No. fields 68
Sq. miles per field . 38

G

Jefferson
Sq. miles 409
No. fields 17
Sq. miles per field . 24

H

Plaquemines
Sq. miles 984
No. fields 33
Sq. miles per field . 30

I

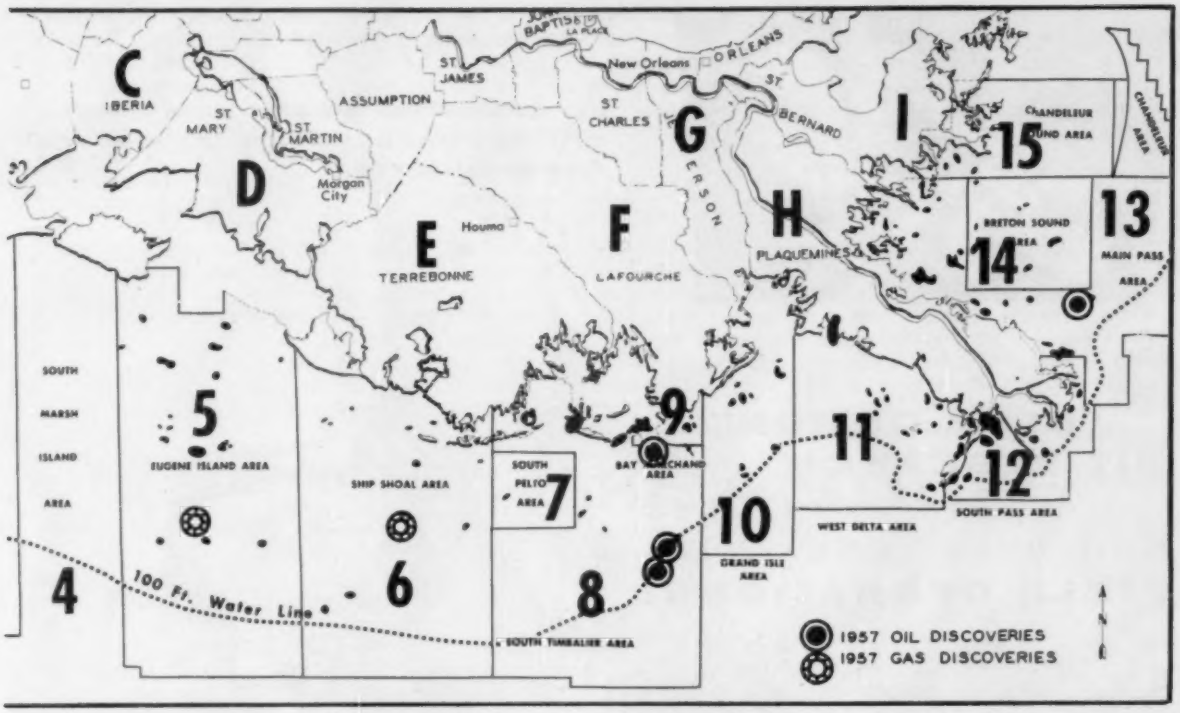
St. Bernard
Sq. miles 510
No. fields 1

Big 2-Year Program

Consequently, it has been only within the last 2 years that offshore exploration has reached sizable proportions, and its potentialities have become fully recognized. Particularly within the past year, as a steadily increasing number of operators and contractors began to get into the play, have new discoveries mounted rapidly. A mounting volume of specialized marine-drilling facilities has come into use; and activity has spread over a wider range. Drilling goes farther and farther from shore and into steadily deeper water.

This year promises a sharp stepup in activity, both in drilling and in new reserves uncovered. Twenty-four entirely new fields were found during 1956. Already this year, through the middle of March, seven more fields have been opened, exclusive of two in process of opening at the turn of the year, and credited to 1956. This was three more than were opened during the same period of 1956. Of the seven fields, four were productive of oil, and three or gas or gas-condensate.

Oil fields opened this year include Main Pass 41, off the east coast of Plaquemines Parish, by The California Co.; Vermilion Block 164, more than 45 miles off Vermilion Parish, by Shell Oil Co.; South Timbalier Block 21, off Lafourche Parish, by Gulf Oil Corp.; and Ship Shoal 107, 25 miles off Terrebonne Parish, by The California Co. (See map).



BORDERING OFFSHORE AREAS

1-2
West and East Cameron
Sq. miles 5,030
No. fields 17
Sq. miles per field .. 291

3
Vermilion
Sq. miles 1,940
No. fields 10
Sq. miles per field .. 194

4-5
South Marsh Island and Eugene Island
Sq. miles 3,475
No. fields 13
Sq. miles per field .. 267

6-7-8-9
Ship Shoal and South Pelto South Timbalier and Bay Marchand
Sq. miles 3,480
No. fields 17
Sq. miles per field .. 205

11-12-13-14
West Delta and South Pass Main Pass and Breton Sound
Sq. miles 2,790
No. fields 35
Sq. miles per field .. 80

15
Chandeleur Sound
Sq. miles 290
No. fields 4
Sq. miles per field .. 73

10
Grand Isle
Sq. miles 635
No. fields 4
Sq. miles per field .. 159

New gas or gas-condensate fields are: Eugene Island Block 172 (Dome B), 45 miles off St. Mary Parish, by Phillips Petroleum Co.; Vermilion Block 96, 25 miles off Vermilion Parish, by C.A.T.C. group; and East Cameron Block 9, 3 miles off Cameron Parish, by Magnolia Petroleum Co.

In the first 2 months of this year, 118 wells were completed in offshore areas. This is nearly a third of the 426 completed in all of 1956. This year's completions include 93 productive wells and only 25 dry holes. Of these, 15 were classed as wildcats, and 103 were in or near existing fields. Nine of the fifteen wildcats proved productive, including the seven new-field discovery wells, and two proved major extensions or opened new-pay zones at known fields.

This year's completions boost to 1,495 the cumulative number of wells drilled in Louisiana's offshore areas. They include 1,094 producers and 401 dry holes.

Offshore fields now are producing more than 166,000 bbl. of oil per day (March allowable). This is a gain of about 56,000 bbl. over the daily average production a year ago, and more than 14,000 bbl. over what it was at the start of the year. The figure excludes condensate recovery from gas-classified wells; this now totals more than 2,000 bbl. per day.

166,000 Bbl. Per Day

Offshore oil production is now nearly 20 per cent of the total for all South Louisiana fields. March production from onshore fields is more than 676,000 bbl., the total for the district being above 843,000 bbl. daily.

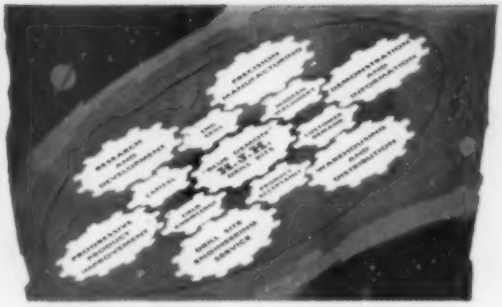
Accumulated oil production of offshore fields through 1956 exceeded 111,196,000 bbl. More than 40,000,000 bbl. of this was produced during 1956.

Gas take from offshore fields, with many of these fields and wells shut in pending provision of pipeline outlets, has mounted to more than 440,000 M.c.f. per day. This is about 141,160 M.c.f. above what it was a year ago. Present production includes some 302,290 M.c.f. per day from gas wells, and 137,765 M.c.f. per day as casing-head gas from oil wells.

Active drilling operations in offshore waters at mid-March totaled about 110, as compared with 75 at the same time a year ago. The number mounts as rapidly as shipyards and other marine builders can turn out drilling structures and tenders and companies and contractors can outfit them and put them to work. All shipyards along the Gulf Coast have been crowded to capacity for some time to meet this growing demand.

Between 45 and 50 companies are now engaged, directly or indirectly, in offshore drilling and producing operations. These are exclusive of those working only as contractors, service, and other auxiliary companies. The total represents at least 18 different groups.

Despite this record of success, the amount of work done, and the build-up of the area to a place of major importance, the true potentialities of the Louisiana shelf have barely been tapped. This is indicated by a comparison of the development of the



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offshore and inshore areas, where sand and reservoir conditions are approximately the same.

Off the Louisiana coast, the Continental Shelf extends under the Gulf of Mexico about 140 miles at its widest point. This is at the Louisiana-Texas boundary projection. Its narrowest point, at the Mississippi River Delta, is 10 to 12 miles. The entire shelf embraces upwards of 50,000 sq. miles. It is the submerged continuation of South Louisiana's landward coastal marsh region. It slopes gently to its outer limits, marked by the Continental Slope, where the bottom starts dipping abruptly into the deep. At that outer limit the water depth is about 600 ft.

The presently accepted feasible limits of drilling with available facilities cover about 20,000 sq. miles. This indefinite limit is roughly marked by the 100 to 120-ft. water-depth contour. Within this contour, the shelf is divided into well-defined, surveyed areas, as indicated on the accompanying map.

Geological conditions in the shelf areas are strikingly similar to those of the bordering inshore parishes lying within the prolific Miocene trend. Therefore, it can be assumed that ultimate development offshore will approximate that of the inshore region, both in number and relative sizes and types of fields.

Total area of the strip of parishes immediately bordering the defined offshore areas (see map) is 8,312 sq. miles. Within these parishes, 206 separate fields have been discovered to date. This represents an average density of one field to 40.35 sq. miles.

Within limits of drilling so far in the adjacent offshore areas, there are approximately 17,640 sq. miles. With 100 fields discovered to date, average density is one field to 176.4 sq. miles.

By these figures, the inshore field density is nearly 4½ times that of the offshore area referred to. On this basis, the number of fields within the present drilling limits of the offshore areas will have to total 433 to equal the density of inshore fields. Thus, it is reasonable to estimate that more than 300 fields remain to be found within the present offshore limits. A comparison of field densities of the offshore and inshore areas is shown on the accompanying map.

In addition to this prospective development, there remains the likelihood that many more fields exist along the outer reaches of the shelf beyond limits of drilling so far.

Some evidence of this is given by the large number of fields which have been discovered on, and in offshore waters close around the Mississippi River's delta-built peninsula protruding seaward off Plaquemines Parish.

The density of fields around the delta is by far greater than anywhere else off the Louisiana coast. This may be because of the greater accessibility of offshore operations around the delta to "inshore" bases and the relatively shallower waters. However, there may be another reason.

The delta peninsula actually is a nature-formed depositional, silty ramp extending seaward on the Continental Shelf. The delta is being built up and extended seaward at the rate of about 300 ft. per year. It now reaches to within 10 to 12 miles of the outer edge of the shelf.

Thus, in effect, even many of the "inshore" fields in the delta area actually are offshore fields being developed from a natural ramp on the shelf, rather from man-made structures or barges in open water. In turn, fields on and around the tip of the delta really are farther out on the shelf than offshore fields elsewhere along the coast.

Consequently, the density of fields around the delta may be indicative of conditions in the outer reaches of the shelf elsewhere along the coast where exploration has been retarded by greater water depths and lack of natural depositional ramps.

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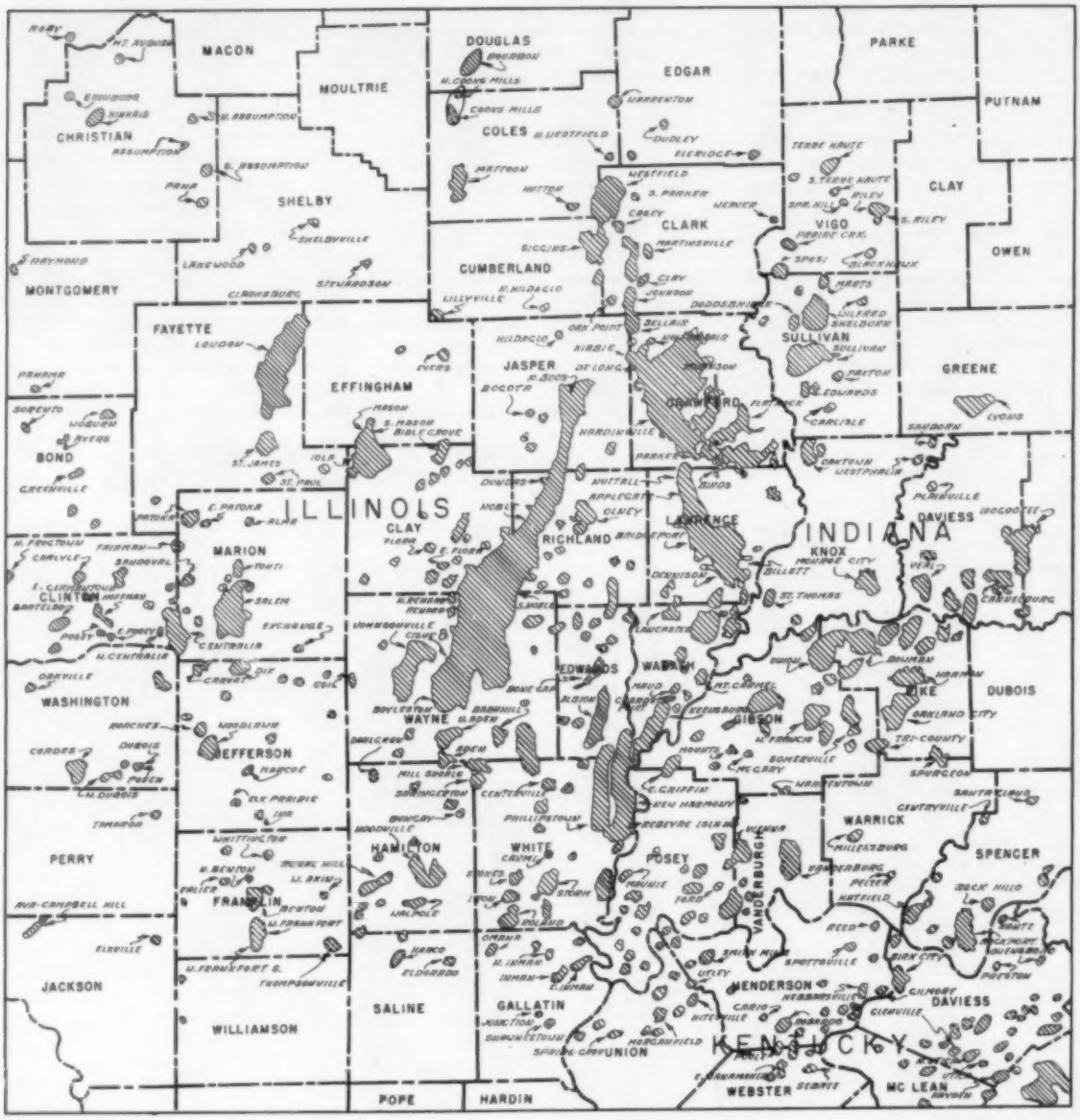


NUMEROUS PAY ZONES at fairly shallow depths make the Tristate particularly attractive to the independent operator. Fig. 1.

Tristate Basin Has 20 Pay Zones

...They're all above 6,000 ft. depth, and producing them is a complex problem for both majors and independents.

by K. G. Boling

EXPLORATION for oil in the Tristate basin has become a complex problem for both the major oil companies and the independent operators. This basin underlies portions of Illinois, Indiana, and Kentucky (Fig. 1); the potential producing area is approximately 250 miles from north to south and 150 miles from west to east. There is production in some 20 different pay zones at depths above 6,000 ft. Practically all known types of oil traps exist within the area except salt domes and their resultant oil traps.

Geophysical prospecting, that is, reconnaissance seismograph work, was done in the period following the depression of the early 1930's and it

proved a very effective exploration tool, resulting ultimately in the discovery of the Clay City anticlinal structure, the Louden-Saint James and the Salem anticlines, and the Griffin Ridge complex. All of these anticlines have proved to be highly productive with production from multiple pay zones.

Seismic surveys are used to find reefs and define reef complexes in the western half and northwestern section of the Tristate basin, as well as in the area due east of the LaSalle anticline.

Gravity surveys are not widely employed in the region. The gravity survey is of a reconnaissance nature and most operators believe it necessary to confirm gravity anomalies by seismic surveys prior to the drilling of reefs or reef complexes.

Magnetometer surveys have not proved effective in the area. However, it has been employed as a reconnaissance tool and is still available locally.

Radioactivity surveys . . . The radioactive survey is a top-secret tool. The results of its use cannot be evaluated or detected, for the cost of the instrument is such that any independent operator or geologist may own and operate this instrument.

One of the first scintillometer surveys in the Tristate basin was conducted by Boling, Levine, and Yabrove, on the Siosi dome of Vigo and Sullivan counties of Indiana. The Siosi dome was a known geological structure with proved production from Pennsylvanian sands and the Devonian limestones. The pool has produced 4,002,973 bbl. of oil. This original survey was made with a scintillometer of the gun type. The survey was run on 1/10-mile stations on a road traverse with average readings of 60-second variations made and recorded on road-map overlays. The results were startling to both the observers and the members of the Indiana Geological Survey who accompanied them. A radioactive halo could be contoured. And the halo contained 95 per cent of the producing area of the Siosi pool. A similar survey was made of the Prairie Creek structure, another reef type of structure of Vigo County, Indiana. This structure has produced 1,478,559 bbl. of oil from the Devonian and its productive limits were completely defined prior to the survey. The radioactive survey gave us a halo on this prospect.

The use of radioactive instruments (i.e., scintillation counters and nuclear radiation counters) in a reconnaissance aerial survey over an area of Raleigh pool, Muddy pool, Harrisburg pool, and the Harco area of Saline County, Illinois, made by Breuer-Robison Oil Co., showed up some complex problems. The plane, a 180 Cessna, unmodified, was used. Altitudes of 200 ft. were maintained by altimeter, under permits issued by the Civil Aeronautics Administration. Two types of instruments were employed, the nucleometer and the scintillometer. The readings were amplified and recorded by automatic recording devices; both were shielded from radioactive navigating instruments. The nucleometer proved unsatisfactory due to the delicate nature of the instrument; tube failure was the most consistent source of trouble.

The scintillometer used was a standard model and the instrumentation was excellent. Variable air speed was one of the most troublesome problems and variable altitude had a marked effect on recorded data. But one of our main troubles was the near-surface presence of coal. This hydrocarbon affected the recordings and showed more shielding effect as it came closer to the surface. We concluded that without modification of the aircraft and the use of radar equipment, surveys made from the air were inaccurate; and the effect of hydrocarbons (coal) near the surface, nullified the effect of deeper radiation shields.

Commercial radioactive survey units mounted on motor vehicles are available locally. The results of these surveys are not known. However, the local exploration chief of a major company employed one of these commercial surveys to find some faults in Kentucky. The faults were known from coal studies of the area, but the instrument failed to verify the presence of these faults. A large independent company has employed radioactive surveys, but its chief geologist is dubious about its ability.

THE AUTHOR

Kenneth G. Boling is a petroleum consultant, Olney, Ill. He was a geologist for Pure Oil Co. in Indiana, Illinois, and Michigan during 1937-48 and served with the U. S. Army Engineers during World War II as an aerial phototopographer. From 1948-52 Boling worked with independents in the Tristate area in responsible positions. Since 1954 he has been an independent consulting geologist operating in the Tristate, South Texas, Colorado, and Nebraska.

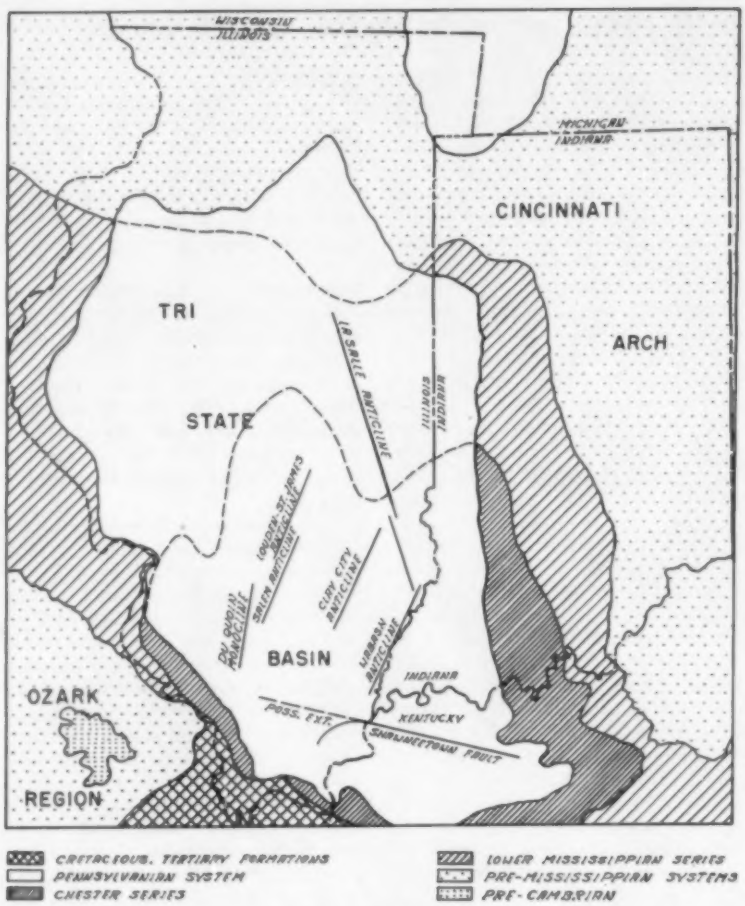
Exploration . . . Core drilling has increased; in 1955 a maximum of five core drills worked a total of 52 weeks. The same maximum number of core drills operated 106 weeks in the first 9 months of 1956. Core drilling, like stratigraphic tests and slim-hole tests, is beyond the reach of any but the major or larger independent companies.

The present use of geophysical exploration, and I refer to seismograph exploration, is regulated, not by its merits as an exploration tool, but by its operational cost. The cost of a reflection-type seismograph crew in the Tristate area is based on a monthly operational charge of $12,000 to $13,000 per month. The coverage is 1½ to 2 linear miles per day on 1,320-ft. spreads. The cost of geograph seismic exploration is at the rate of $25,000 per month, plus tapes. The amount of area covered per month by seismic exploration is directly related to the type of shooting done, whether reconnaissance or detail. Reconnaissance shooting is more or less a thing of the past and detail shooting is almost a prerequisite.

Geological approach . . . Cost of prospecting is a prime element in the search for oil in the Tristate. The results of seismic surveys on rank wildcat are 4.5 per cent successful (rank wildcat as used here is 3 miles from production). The geological approach is equally as successful.

The geological method, with a production test drilled to the target horizons, has an average cost of approximately $12,000 to $16,000 for the well, plus the cost of the acreage and incidental geological prospect costs.

The Tristate geologist has an abundance of information. Some 48,111 wells were drilled in Illinois alone, from 1936 to 1955. Completions in Illinois for 1956 will be somewhat fewer than 1955's total of 3,885 wells—the greatest number of wells drilled in any one year, since 1907, when 4,988 wells were drilled. When Indiana and Kentucky well records are added to this score, 75,000 to 80,000 well records are available. The enormity of the stratigraphers' task is exemplified by an area in Hamilton



PRODUCTION is closely related to stratigraphy and the principal geologic trends in the Indiana-Illinois-Kentucky region. Fig. 2.

County, Illinois; here seven townships contain 4,000 wells, and here incidentally, the projection of the Aux Vases sand bars yielded extentions to known fields with reserves almost as great as those of the original pools.

Sources of information . . . The Illinois Scout Association and the Indiana, Kentucky Scout Association are aggressive groups who have, for the most part, compiled the well records; and these groups have provided the free exchange of information that has made subsurface exploration of the Tristate an effective tool.

The Illinois State Geological Survey at Urbana has an almost complete well-data file going back to 1900. The Indiana State Geological Survey at Bloomington has completely renovated its files of well information and modernized its procedure to the point where its records are second only to Illinois. The Kentucky State Geological Survey had a disastrous fire that wiped out its files completely; however, it has made a fast and rapid recovery, with a completely modernized set of well records. These state surveys are highly cooperative, and deserve a vote of thanks from the oil industry, since a phone call will give an immediate answer, if the data needed are available.

The electric-log records of the Tristate are very complete. Where electric logs are available, Schlumberger Well Logging Service Corp. at Evansville, Ind., will supply copies of released logs at a minimum cost. Mid-Continent Map Co. at Mattoon, Ill., also offers microfilmed electric logs, on a yearly basis. Halliburton Oil Well Cementing Co.'s logging department at Flora, Ill., will gladly furnish copies of its logs, where available.

The two independent scouting services: Jerry Robertson's Oil Report and Virgil Kay's Report published weekly in Evansville, Ind., keep the independent operator and other companies supplied with detailed information.

Competition keen . . . Oil exploration by geological methods, that is, the use of all well records and electric logs, is a highly competitive business. There are approximately 225 graduate geologists operating in the area. At least 75 of these geologists are independents, who are not affiliated with any one organization. Most independent companies employ one geologist, who is responsible for exploration, the checking of deals, and well-watching. He is pitted against major-company organizations of 10 to 15 men who carry on the routine tasks and geological exploration, mostly on an area, or district basis. Major companies in the Tristate basin have long adhered to a policy of leasing large blocks of acreage, on either geological or seismographic structural anomalies. The trend in geological thinking is toward area sand maps. And should a major company apply this theory with a vigorous lease program, it could come up with some very successful stratigraphic prospects.

Some progressive independent companies set up "deal factories" or "exploration mills." These are geologic teams, composed of a senior geologist, a junior geologist, and a secretary. This team and secretary, who doubles as a file clerk, are a combination which works fast and effectively and can efficiently cover an amazing amount of detail in a short period of time.

The direction of the land department by the exploration department is an important step in the Tristate land situation. There is a perpetual leasehold race and man-hours are lost to the organization when an exploration prospect is found to be leased by another company. By coordination between the two departments, the time slack goes out of the picture and allows for a hard-hitting lease program.

Activity varies . . . A leasing program in the Tristate runs the gamut of hot and cold areas. Hamilton and Saline counties in Illinois were hot areas in the last 2 years; the cost per acre ran from $25 to $50—with some fantastic intercompany deals in the Eldorado and Harco areas. Coles and Douglas counties in Illinois caught fire with the Bourbon-Cooks Mills discovery and the acreage cost jumped from $10 to $40 per acre. Clay, Richland, and Wayne counties in Illinois have long been in the stable areas of pool extensions and lease costs of $10 per acre prevail. The farm and royalty owners in the Tristate are oil smart; therefore, short-term leases and drilling commitments are common. Wabash and Edwards counties of Illinois; Posey, Gibson, and Vanderburgh counties of Indiana; Union, Webster, and Henderson counties of Kentucky; these are all areas where the lease-

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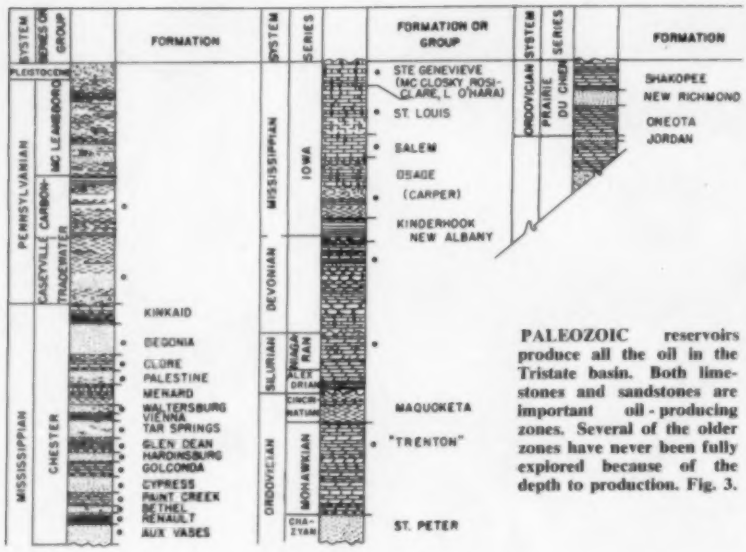

PALEOZOIC reservoirs produce all the oil in the Tristate basin. Both limestones and sandstones are important oil-producing zones. Several of the older zones have never been fully explored because of the depth to production. Fig. 3.

man pitch is nothing new; hard money and drilling commitments are common requirements. Southern Illinois and North Central Illinois have complex title problems in the form of coal and other mineral deeds. These deeds were written prior to the advent of oil. Kentucky title work is a province all its own—the metes and bounds descriptions, and the lack of recorded titles make very interesting problems for the land and title man.

Geology

The Tristate geosyncline is a major basin, sometimes referred to as the Eastern Interior basin or the Illinois, Indiana, and Kentucky basin (Fig. 2). This basin was one and a part with the Michigan basin until pre-Devonian time, when the northwestern arm of the Cincinnati arch, i.e., the Kankakee, became a relatively stable anticlinal area and the Michigan and Tristate basins subsided separately.

One of the largest major features of the Tristate is the La Salle anticline, that is approximately 200 miles long, traversing the State of Illinois from the north central portion to the southeastern portion of the state. This en echelon anticline produces oil for almost 120 miles of its linear distance Most of this production is the Pennsylvanian system, mostly from the Tradewater and Caseyville sandstones. This old shallow production is the reservoir that has such spectacular waterflood performance. It is the balance wheel that stabilizes oil production in Illinois.

The second major structural feature is the Shawneetown Rough Creek fault. This thrust fault traverses the southern portion of the basin from west to east, and theoretically, turns almost due south near the town of Equality, east of Harrisburg, in Saline County, Illinois. However, two dry holes, one west of Harrisburg in Saline County and one in southeastern Williamson County have shown double sections, almost mirror reflections, on the Glen Dean limestone and the Hardinsburg sand. The impact of these two bits of evidence—namely, a continuation of a thrust fault through Saline and Williamson counties of Illinois—has yet to be exploited. A thrust fault can mean doubled pay sections in an oil well.

Other structural features trend for the most part north-northeast by south-southwest. The most complicated structure is the Wabash anticline, or the Griffin Ridge complex—a structure and fault complex trending roughly down the Wabash River between Indiana and Illinois. This complex consists of two horst areas, and a structure within a graben; it includes the highly productive New Harmony Consolidated oil pool and Phillipstown oil pool, where 2,178 wells have produced 101,622,407 bbl. of oil.

The Clay City anticline of Jasper, Richland, Clay, and Wayne counties, Illinois, is an en echelon fold, some 40 miles long, trending from the La Salle anticline area south-southeast until lost in the deeper part of the basin. This anticlinal area has been very productive of oil; its 3,416 wells have produced 185,050,347 bbl. of oil.

The London-St. James anticline of Fayette County, Illinois, is over 30 miles in length and has produced a great quantity of oil — 194,874,115 bbl. from 2,082 wells. The Louden area is undergoing an intensive waterflood program.

The Salem anticline, a prolific structure, although only 10 miles long, had 10 pays that produced. This field, now under a spectacular water flood, has produced 250,409,623 bbl. from 2,374 wells.

The Centralia anticline is a small structural anticline about 6 miles long that has produced 39,222,223 bbl. from 590 wells.

The Du Quoin monocline, running north and south from Du Quoin in Perry County, Illinois, seems to pose a boundary line, west of which there are no major structural features of the magnitude of those of Central Illinois; this area presents an exploration challenge.

Indiana has a series of faulted anticlinal structures, paralleling the Wabash River anticlinal trend. These are known as the Farmersville, Bufkin, Caborn, Owensville, St. Wendells, and St. Phillips structures, located in the tricounty area of Posey, Gibson, and Vanderburgh counties.

Kentucky is no stepchild of Illinois and Indiana. Union, Henderson, Webster, and McLean counties of Kentucky are affected by the same type of deformation that created the Wabash River anticline and its parallel structures; the Shawneetown-Rough Creek fault and its complexes have highly complicated the structural picture. South of the Shawneetown-Rough Creek fault, there is a highly complex fault system, where little subsurface control is available and coal and surface geology must be used.

There has been little or no aerial photogeology used on this area; but that technique could be applied on areas where the Chester series crops out. Areas where the Pennsylvanian system is on outcrop would not yield satisfactory results by aerial photogeology. However, these areas could be prospected on the basis of coal information and core drilling.

Strat traps in the forefront . . . In the Tristate, the structural geologist or "hickey hunter" has had his day, successful as it might have been; he has had to graduate to the stratigraphic department and look for strat traps in producing horizons.

The stratigrapher's task in the Tristate is conducive to ulcers. He has 20 possible pay horizons (Fig. 3) to work with and 75,000 to 80,000 test holes to work from. Few, if any, of his Chester pay sands are readily identifiable from sample analysis, one from another, except by the identification of related limestone marker beds. Electric logs simplify the problem on correlation and identification of possible pay horizons. The

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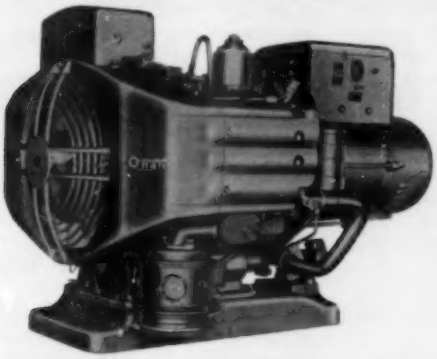

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stratigrapher is aided by his knowledge of the area, as to what pay horizons have been most productive in the particular area under study.

● **The Pennsylvanian system** has produced one-sixth of the oil in Illinois, usually from the Tradewater and Caseyville groups. Although these sands have many local names—Casey, Bridgeport, Robinson, Mansfield, and Biehl, to name a few—they are usually medium to coarse-grained micaceous sandstones and generally have fair porosity, when they are clean. The permeability of the sands is in general moderate, with a maximum of approximately 250 md. The producing sands are, in general, found at shallow depths, 400 to 1,400 ft. in the vicinity of the La Salle anticline, and the associated Wabash River complex. The shallow sands do not generally have a high bottom-hole pressure; the reservoir drive is usually gas-expansion type. Because the gas expansion drive is not efficient, these sands, at a shallow depth, lend themselves to an economic water-flood venture. They are being systematically water-flooded by both the independent operators and the major oil companies.

● **The Chester sandstones** are the primary target zones for exploration in the Tristate basin. They have accounted for over one-half of the total oil production. The Upper Chester section includes the Degonia, Clore, Palestine, Waltersburg, and Tar Springs sands that have oil-producing history. The Clore, Palestine, and particularly the Waltersburg, are depositional-type traps. It is their lenticular nature that controls their ability to produce oil.

David Swann has described the Waltersburg sand, the very prolific and spectacular producing horizon of Eldorado pool of Saline County, Illinois, as to depositional characteristics; this work appears in his "Waltersburg Sandstone Oil Pool of Lower Wabash Area in Illinois and Indiana," Report of Investigations No. 160, Illinois State Geological Survey. This bulletin is a basic must for stratigraphers working the Waltersburg in the Tristate area.

● **The Lower Chester series,** the Cypress, Benoist, and the Aux Vases sandstones, are primary target zones for oil production in the Tristate. The Cypress is identified as the first sand complex below the Barlow limestone, and can best be correlated by zone method, based on equal division of 20 ft., from the base of the Barlow. Therefore the Cypress Zone No. 1 becomes the Weiler sand of Clay County, Illinois—the most prolific of the Cypress beds.

This sand ranges from 6 to 20 ft. and if it is found oil-saturated, becomes a must for a drill-stem test. Cypress Zone No. 2, the so-called Stray sand, produces in local areas. Cypress Zone No. 3, the big water sand, can have a producible amount of oil above the oil-water contact. This bed has been found fully saturated in the southwest and western part of the Tristate basin.

● **The Benoist** (Bethel sand) usually not productive in the deeper parts of the basin, has been a prolific producer on both the eastern and western flanks of the basin. This sand is generally fine to medium-grained; its characteristic color is light green; it usually contains some small discontinuous shale partings. The porosity ranges upward from 16 per cent with about 22 per cent maximum. The Benoist generally has an active gas-expansion drive.

● **The Aux Vases** sandstone is the darling of the hydraulic-fracture enthusiasts. This sandstone is productive in the east-central part of the Tristate basin. It is a relatively fine-grained sand, containing certain clay minerals that react with drilling fluid to restrict the flow of oil into the bore hole on a drill-stem test. This dirty sand has a characteristic electric-log kick that, in the early days, was identified as water.

This, coupled with the fact that the small sand grains floated out on the drilling fluid, led to the plugging of a lot of old exploration holes. One other characteristic of this sand, long unsuspected, was the high degree of crossbedding. Hydraulic-fracture-method completions on this sand have been spectacular. Instances have been cited where core analysis gave zero permeability at the bore hole. And yet, after fracture, the well made 40 bbl. per hour after load oil was recovered from the hydraulic-fracture technique.

● **The Lower Mississippian** section has the highly prolific, oolitic, limestone beds of the O'Hara, Rosiclaire, and the Fredonia. All these porosity zones comprise the so-called McClosky zones of the Tristate basin. The O'Hara (lower O'Hara) is an oolitic bed, in the contact of the Chester and Lower Mississippian. This zone, in general, has an unsavory producing history. It will, in general, flow on a drill-stem test, and then fail to pay for itself after completion, due to the limited size of the reservoir. However, there are O'Hara reservoirs that have been prolific. The bed, in general, is regarded as a "kicker," to help increase the gross production of a well. Gards Point pool, in Wabash County, Illinois, discovered in 1956, is going to make commercial production from the O'Hara.

The Rosiclaire is generally regarded as the first oolitic bed under the typical green-brown coarse-grained oolitic zone, identified in the deeper part of the basin as the Rosiclaire marker. This zone, often regarded as the first zone of the McClosky, or the upper break of the Fredonia, is a very prolific producing horizon. Its porosity ranges from 12 per cent to 15 per cent. The permeability is usually high, with 1,000 to 1,200 md.

In many instances, the reservoir may have an active aquifer. If it does not, it reacts to the dump water flood, or float-out. Some wells in this zone recover between 100,000 and 150,000 bbl. of oil per 20-acre location, after acid treatment. The Rosiclaire goes into a pure quartzitic coarse-grain sandstone in the west and northwest sections of the basin. These pure sands react to hydraulic fracture methods.

The Fredonia limestone lies below the Rosiclaire sandstone member of the Lower Mississippian, in the central part of the basin. These oolitic limestones are well developed and fairly widespread throughout Clay, Richland, and Wayne counties, Illinois, and become more erratic as they approach the flanks of the basin. The oolites are in general smaller and better sorted than those of the Rosiclaire. Porosity and permeability are very similar to those of the Rosiclaire.

All the so-called McClosky zones are lenticular depositional phases and do not, in general, correlate from one producing area to another.

The Salem limestone became headline news in 1956, with a flowing discovery at the old Dalgren pool, 3s-5e, Wayne County, Illinois. The Salem limestone is no Johnny-come-lately to the Tristate basin. The first commercial Salem of the late 1937 flurry was in Salem pool, Marion County, Illinois, where eight producing wells were drilled. The Salem is typically described as a porous zone in an oolitic limestone; however, sample examinations of the Pure Oil Co. 5 Honey in Jasper County, Illinois, show a very fossiliferous zone that is from 20 to 100 ft. thick, with unlimited permeability and a water-drive reservoir mechanism. This Salem is a zone to be reckoned with as a producing horizon. The Salem is roughly 500 ft. below the top of the Lower Mississippian formation.

Approximately 500 ft. below the top of the Salem we get into the Salem-Warsaw contact. Here is a zone to delight the heart of any discontented producer. The Magnolia Petrole-

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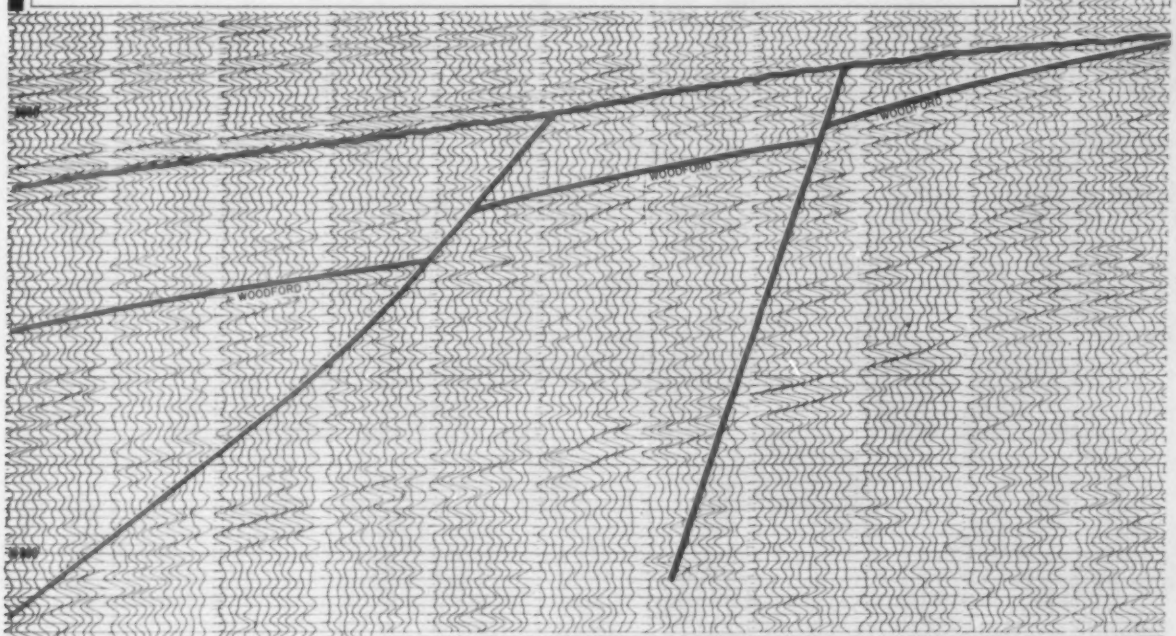

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um Co. 1 Jones in 10-3s-2e, Jefferson County, Illinois, has a typical development of porous fossiliferous limestone, approximately 45 ft. thick. In Magnolia's well, this highly porous zone carried a show of oil that was also present in the Dalgren well.

There are definite drawbacks to these zones:

1. They are 1,000 ft. too deep for standard Illinois drilling deals.

2. They have very sharp oil-water contacts that play havoc with all but the best completion practices. These are relatively unexplored zones and definitely need further exploratory drilling. But, if the Salem and the Salem-Warsaw are ever found completely saturated, the boom is on again.

Stratigraphers are restudying the Carper sand of Devonian age. It was discovered in Martinsville pool of Clark County, Illinois, and then described by G. F. Moulton in 1926; this sand in 30-10n-13w, Clark County, Illinois, has lately (1956) turned up with 80 to 100 ft. of oil saturation. This zone reacts to hydraulic fracture, and is relatively unexplored.

● **The Devonian formation** is the will-of-the-wisp of the Tristate basin. This horizon is normally productive on the Silurian reefs of western and northwestern Illinois and northwestern Indiana. The production is generally from a porous dolomite that is draped over a Silurian reef. However, there are many reported shows of Devonian oil on the low-lying structures of Central Illinois and Indiana. Early seismograph surveys reveal the presence of Devonian structure, but they fail miserably to define the areas of Devonian porosity. The latest 1956 discovery of a Devonian reef is Germantown East pool in Clinton County, Illinois, where National Associated Oil Co. has had some very excellent wells from the Devonian "overdrape."

Sorento Consolidated pool of Bond County, Illinois, is a 1956 development of a known structure. Here the Dutch Creek sandstone has been found productive. This horizon is below the usual productive zones of the Devonian draped over a reef. This sandstone is very porous.

Our most productive discovery of the year has been Kincaid pool of Christian County, Illinois. This pool is officially producing from the Hardin sandstone. This horizon is described as a member of the Chattanooga (Kinderhook, New Albany) shale. The term is applied rather loosely to this zone; it is apparently a reworked, fragmental zone of detrital Devonian that has been carried downflank on the bald spot of Sangamon and Christian counties, Illinois. This is an area where the Devonian limestone is completely removed from the section and the controversial black shales of the Lower Mississippian or Devonian age overlie the Silurian. This zone seems capable of sustained production. These wells at Kincaid pool came in with initial potentials of 400 to 500 bbl. per day at 1,750 to 1,800 ft. and they have held up. They are an exploration geologist's nightmare. There is no other known Devonian bald spot, and how to find the so-called Hardin sandstone is a good problem for the puzzled experts.

● **The Silurian** also produces on and near the bald spot. This zone is quite unspectacular. The producing horizons are dolomites with broken porosity zones, detectable only by MicroLog methods. The broken zone may extend over a section 100 ft. thick and it will produce oil. The wells sustain production, but there is much doubt as to their commercial value.

The Trenton of Ordovician age is the oldest known bed producing in the Tristate basin. It is limited in producing area to the west and northwest flank.

Drilling results . . . Indiana and Kentucky statistics are not available as yet, but an analysis of Illinois drilling is shown below:

New pools	Extensions	Near	Far	Total wells	Year
35	85	429	307	856	1955
16	70	402	329	817	*1956

*January to September.

The Tristate has the following commercial pools discovered in 1956:

Harco—Saline County, Illinois—Aux Vases sand.

Cooks Mills—Coles County, Illinois—Rosiclaire sand.

Bourbon—Douglas County, Illinois—Rosiclaire sand.

Kincaid—Christian County, Illinois—Hardin sand.

Germantown East—Clinton County, Illinois—Devonian limestone.

Sorento Consolidated — Bond County, Illinois—Devonian limestone.

Gards Point—Wabash County, Illinois—O'Hara limestone.

Madisonville West — Hopkins County, Kentucky — O'Hara limestone.

There is a fundamental need for deep-horizon exploratory drilling. Prospects must be well defined by subsurface geology, verified by geophysical methods, and backed up by stratigraphic or sample studies.

The independent oil operator in the Tristate basin has had a hard year; a steel strike, the government tight-money program, a steady rise in the cost of drilling, completion costs, and no increase in the price of oil—these factors limited many operators to drilling possible extensions to known oil fields.

Exploration during 1957 in the Tristate basin can be quite hectic. The Suez-influenced price increase should stimulate drilling. Good, sound drilling deals were at a premium in 1956, and they will command an even higher premium during the coming year. Sound exploration techniques for a mixed drilling program of extension-type deals and wildcat deals should give the operator and investor a better discovery rate and higher investment returns for the coming year.

The man investing money in Tristate oil should be sure of his fundamental geological facts. Operators and investors could, and would, save money, if they were sure that the deal under consideration was completely checked by a reputable geologist with access to the many records in the Tristate basin. Exploratory drilling is necessary and expensive. But if one dry hole a year was eliminated, the resulting savings would pay for the operational cost of an average geological department and still leave a profit.

Water-flood oil is important to the Tristate and comprises almost 40 per cent of the average daily production. Sound water-flood development projects in the Pennsylvanian and Chester sands are good investments dollar-wise when they are available. Any such prospect, however, must be checked out completely by a good geological and engineering report, for the best of these prospects are under development.

Acknowledgment . . . I am indebted to the following persons and wish to take this opportunity of thanking them for their wholehearted help and contributions in assembling this article:

Dr. A. H. Bell, head of Oil and Gas Division, Illinois State Geological Survey, Urbana, Ill.

Dr. David H. Swann, Illinois State Geological Survey, Urbana, Ill.

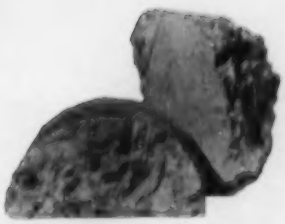
Margaret O. Oros, assistant geologist, Oil and Gas Division, Illinois State Geological Survey.

Tom Dawson, head petroleum section, Indiana State Geological Survey, Bloomington, Ind.

Dr. David J. Jones, state geologist, Kentucky Geological Survey, Lexington, Ky.

Chester Geiger, Carter Oil Co., Mattoon, Ill., secretary-treasurer, Illinois Scout Association.

Carl F. Pampe, division geologist, Pure Oil Co., Olney, Ill.



MISSISSIPPIAN CHERT

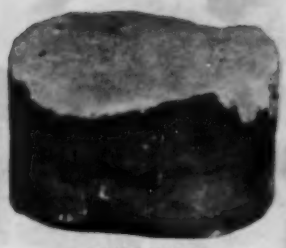
Kay County, Oklahoma

Responds well to Sandfrac*. Typical treatment: 750 gals. refined oil per foot of pay, and 1½-2 lbs. sand per gal. Injection rate: 30 BPM. Petrojel* successful but use limited by lease crude storage cost. Excellent results with Riverfrac*, but water shortage limits its use here.

YATES

West Texas — New Mexico

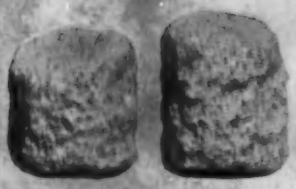
In certain areas, such as Shafter Lake Field, Andrews County, Texas, Riverfrac has been successful in many wells after all other treatments had failed. Typical treatment this field: 35,000-40,000 gals. fresh water, 20,000 lbs. sand. Injection rate: above 25 BPM recommended.



"D" SAND

Denver — Julesburg, Colorado

BHT frequently exceeds 225° F. Sandfrac, using refined oil, preceded by Mud Acid, generally used. Results vary widely, depending on degree of depletion. Typical treatment: 400 gals. Mud Acid, 10,000 gals. oil, 10,000 lbs. sand. Injection rates: 5-10 BPM through tubing, 10-20 BPM through casing.

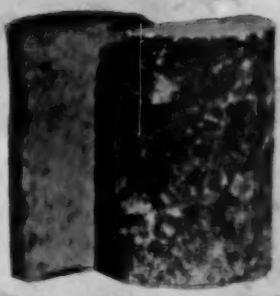


LOWER FRIO

South Texas

Treatment of tight intervals depends mainly on depth and bottom hole temperature. Petrofrac* recommended for shallow wells with BHT under 150° F; Petrojel where BHT range is 150° F—180° F. In deep, high BHT wells, Stratafrac* or Acid Petrofrac* gives excellent results.

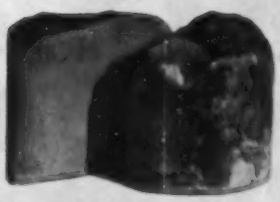
Dowell guide to fracturing



MISSISSIPPIAN CHAT

Barber County, Kansas

This formation, although only slightly soluble in acid; responds well to Acid Petrofrac. Typical treatment: 1,000 gals. fluid and 1,000 lbs. sand per foot of perforation. Injection rate: 30 BPM. Results on gas wells generally ten times drill stem test.



TENSLEEP

Big Horn Basin, Wyoming

Tight Pennsylvanian Sandstone, usually requiring high injection pressures. Normal treatment is down tubing. Widely varying depths and BHT. Petrojel successful in shallower sections where BHT is under 180° F; Sandfrac, using refined oil, preferred in deeper wells with higher BHT.

CARDIUM CONGLOMERATE AND SAND

Pembina Field, Alberta

Conglomerate interval normally prolific without stimulation. Sand usually requires fracturing. Sandfrac, preceded by Mud Acid, gets good results. Typical treatment: 500 gals. Mud Acid followed by 20,000-30,000 gals. lease crude with 40,000 lbs. sand. Injection rate: 20-30 BPM.

These cases give general information about treatments which have been successful in the formations shown. However, each well has its own unique characteristics which require the attention of experts. Dowell engineers have gathered performance data from fracturing operations in most active fields in the United States and Canada. Chances are that they already have the answer to your particular treating problem. If not, the Dowell laboratory and engineering staff is at your service. Dowell Incorporated, Tulsa 1, Oklahoma.

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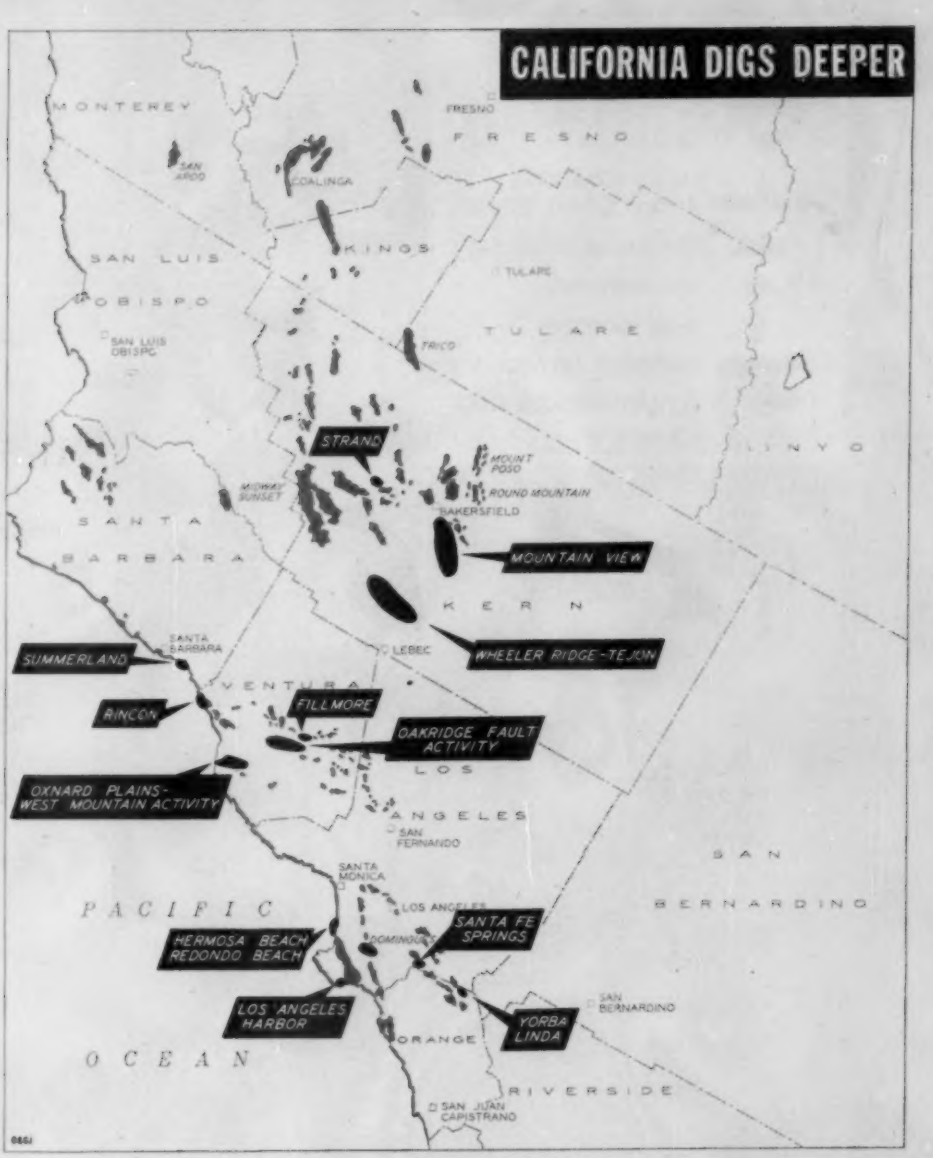


THE wildcat drill is aimed at deep prospects in the Ventura and Los Angeles basins, and in the San Joaquin Valley as Californians look for most of their new oil in and around older areas.

by **Bill Smith**
District Editor

Offshore Setback Again Forces California To Probe Deeper in Known Areas

WITH California's offshore work set back a year, the state's operators are again looking to deeper drilling in and around known producing areas as their hope for finding new reserves this year.

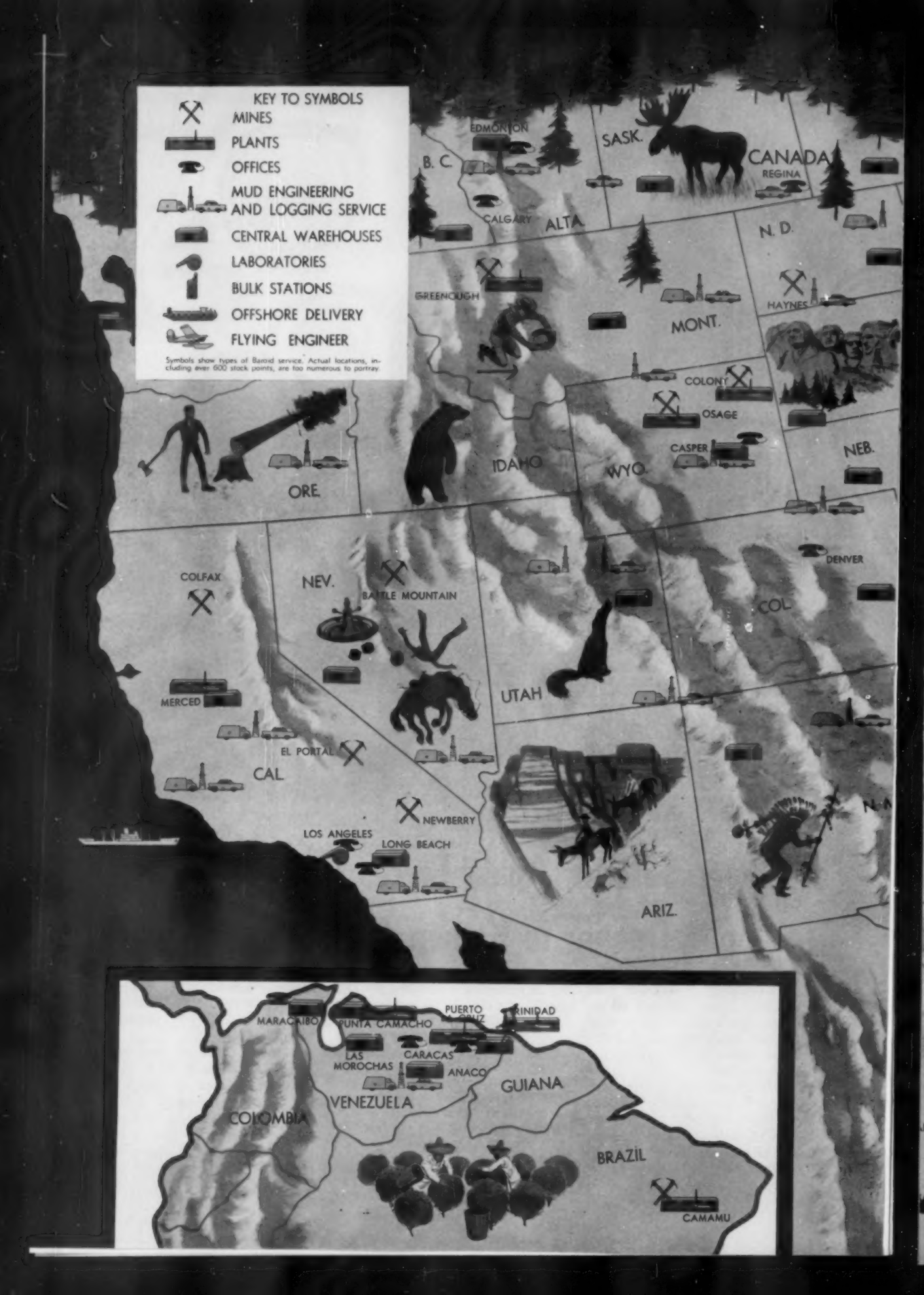
Success of this type of exploratory drilling has accounted for the bulk of the state's new oil in recent years.

In 1954, the state recorded 31 new field and pool discoveries. Seven of these were discovered by deeper drilling in producing areas and accounted for 56 per cent of the total production from new reserves that year.

In 1955, 9 out of 41 new discoveries were of the deeper-drilling variety. These nine produced almost 40 per cent of the new production that year. Although final figures are not available, the same picture is indicated in analyzing last year's exploratory work.

Offshore . . . Two offshore areas are definitely scheduled for exploratory drilling this year. They are a 500-acre and a 5,500-acre parcel, both off Summerland.

Richfield Oil Corp. was building an artificial island in 45 ft. of water 3,000 ft. offshore at Rincon from which it will develop its 1,175-acre lease. However, drilling on this lease won't start until next year. This lease was awarded prior to passage of the Cunningham-Shell Act of 1955. It was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given to Richfield on the basis that onshore production was probably draining the state-owned submerged land.

Standard Oil Co. of California and Humble Oil & Refining Co. just barely beat the lowering boom on state-owned tideland leases by getting the 5,500-acre lease at Summerland last December for a bonus bid of $7,250,000. Shortly after the lease was awarded, the State Lands Commission, at the request of the state legislature, halted all offshore leasing on state submerged lands.

Standard-Humble now have Pacific Driller No. 1, the state's first drilling platform, at work on a core-hole program on the lease.

Under the terms of its lease, Standard-Humble can either develop the acreage by slant-drilled wells from onshore sites or from offshore structures. If offshore islands or platforms are used, they must be at least 1 mile from shore and be able to accommodate at least 20 wells each.

This lease involves acreage adjoining the old onshore Summerland oil field but is not considered as within the field's producing structure so is classified as wildcat land.

Tidewater Oil Co. has announced plans for a 6,000-ft. test to be slant-drilled from onshore at its 500-acre offshore lease adjacent to Summerland oil field. Tidewater was awarded this parcel last July for a bonus bid of $75,000. It is considered within Summerland field's producing structure so is classified as proved acreage.

Other than those three leases, excluding municipally owned tidelands, offshore work on state tidelands will continue to consist in the main of stratigraphic and core work from floating drilling barges. Eleven craft are now engaged in this type of work.

Ventura basin . . . The big play in this coastal area will be along the Oakridge fault. Operators will try to link up the Pliocene pools now productive in four places along the 20-mile-long fault.

Prior to the discovery of Pliocene production in Basolo pool at Shiells Canyon in 1952, all production had been from Miocene or Eocene sands found above the steeply overturned fault. Some of this production dates back to 1895.

With the Basolo pool discovery, operators began a serious search for additional Pliocene production by deeper drilling on the flanks of these old fields. This exploration was conducted by either slant drilling under the fault, or by drilling straight through it.

The Texas Co. touched off a drilling boom along the fault last year with a prolific discovery in the Bridge area of South Mountain field east of the town of Santa Paula. Here Texaco, as operator for itself and Union Oil Co., found Pliocene production at 8,000 ft. Neighboring South Mountain field has been producing from Miocene formations at an average well depth of 4,467 ft. since 1916.

Since Texaco's discovery, the Bridge area has been extended about 1½ miles in length and ¾ mile wide. There are currently 11 rigs active in this play.

Four miles southwest of the Bridge area, Shell Oil Co. scored a major discovery in 1955 by tapping at least two Pliocene pools at Saticoy. Shell is continuing to extend this field with stepouts and offsets.

Almost 8 miles east of the Bridge area, Union Oil hit Pliocene production on the west edge of Bardsdale field also by drilling through the Oakridge fault last year.

None of these new pools, fields, and areas is completely defined so will continue to see steady drilling activity.

Three miles east of Bardsdale, Western Gulf Oil Co. was rigging up for a 9,000-ft. test of the Wiley anticline. This anticline is the only one of the six anticlines strung along the Oakridge fault which has never been productive.

Another region in the Ventura basin seeing increased activity is the Oxnard plains around the town of Oxnard.

Standard and Texaco are currently working on stepouts of a Sespe pool Standard discovered late last year 1 mile west of Oxnard field.

Standard is also active at West Montalvo where it has six rigs working on deep tests of both onshore and offshore holdings. The offshore wells are being drilled from onshore sites along the beach. The state lease offshore at West Montalvo was awarded Standard several years ago.

Farther inland, an area attracting increasing interest is the deep play west of the town of Fillmore.

Standard, Richfield, and Humble have production there. Development of this field has been in a northeasterly direction since its discovery by Standard in 1954. Exploration has been costly and marked by frequent 14,000-16,000-ft. dry holes. Average well depth is 14,250 ft. An unusual feature of drilling at Fillmore is that operators frequently have 10,000 ft. or more of uncased hole during drilling. At this writing Humble had two rigs working there and Standard and Richfield one each.

Richfield recently extended production here ½ mile east with completion of a 14,020-ft. wildcat, 1 McNab, in SE NW 25-4n-20w. This well is the farthest east in the 2-mile-long productive area. It is less than ½ mile west of the town of Fillmore.

San Joaquin Valley . . . Three areas in the San Joaquin Valley are tabbed as the most likely to see continued or stepped-up exploratory drilling. They are Wheeler Ridge-Tejon, Mountain View, and Strand.

Wheeler Ridge is an old friend to California exploration. New discoveries continue to turn up there either from deeper drilling within the known productive areas or deeper drilling on its flanks.

First production at Wheeler Ridge was found in 1922 at 2,834 ft. Since then zones have been found at levels to 10,000 ft. and in every direction from the discovery area.

This year's exploratory drilling there will be confined largely to the 4 miles separating it from Tejon field to the east.

Last year Richfield proved up Vedder production in a new pool in the Windgap area almost 2 miles southeast of Wheeler Ridge and 1½ miles northwest of Tejon field. Richfield also recently tapped a new JV sand pool ¾ mile northeast of the Windgap area find. Extension efforts on these two pools will keep several rigs busy this year. Richfield now has five rigs active in and around Wheeler Ridge field.

Reserve Oil & Gas Co. has been the most active on the Tejon field part of this play. It recently made an important Vedder pool discovery at a location more than 3 miles north of regular Tejon field production.

Mountain View field, particularly around the town of Arvin, is also slated for exploratory and extension test drilling.

Union Oil is the pace setter here with an important upper Miocene pool discovery west of Arvin last October. Union found Stenderup pool at 9,535-9,717 ft. The discovery flowed 1,170 bbl. initially of 27.4°-gravity crude. Two offsets have since been successfully completed while a southeast offset failed to find the zone and was abandoned at 9,765 ft.

Union was readying a site for another Mountain View wildcat in SE SE 27-31s-29e, almost 2 miles southeast of its Stenderup pool wells.

Strand field 10 miles east of Bakersfield continues to chalk up new pool discoveries. In 1955 Shell Oil Co. scored four discoveries there.

Last year both Shell and Union tapped new pools. Union's find, while not the most productive, involved the greatest distance from the proven acreage . . . about 1 mile northwest. None of these pools has been completely defined and will see continued drilling this year.

The goal at Strand is the Stevens sands at between 8,000 and 9,500 ft. and the Vedder at 12,000 ft. plus. Bulk of the activity is in a northwest-southeast direction in Sections 12-30s-25e and 7-30s-26e.

Los Angeles Basin . . . Here, perhaps more than anywhere else in the state, deeper drilling in and around proven acreage has accounted for the most successes in recent years. Such old names as Santa Fe Springs and Dominguez saw increased drilling last year resulting from deeper discoveries either within or on their flanks.

The major find in the basin in 1956 was at Santa Fe Springs field east of Los Angeles.

General Petroleum Corp. discovered the Santa Fe zone at 8,524-9,010 ft. with a well drilled almost in the center of the old producing area. This discovery gave this old field its eighth producing zone, one stacked on top of the other. Production at Santa Fe Springs dates back to 1919.

The General Petroleum discovery touched off a drilling boom which at one time saw 23 rigs active in the field.

The field saw two other new pool discoveries before the year was up, neither of the size of General Petroleum's Santa Fe zone, however.

The more important of these latter two is Edward Nepple's Pedro pool find on the extreme west edge of the field. Nepple found this new pool, an equivalent of G.P.'s Santa Fe pool but a different fault-block accumulation, at 9,443-10,152 ft. Two offsets have been completed since then, both in the 200-bbl.-plus class.

The other discovery was Newgate pool found by Western Gulf Oil Co. 1 mile southeast of regular Santa Fe Springs field production. Western Gulf has had to redrill and recomplete this well several times since its original completion last September. This appears to be a small fault-block accumulation and is not considered of major importance at this time.

At Dominguez field in south Los Angeles, Union Oil and J. K. Wadley were active last year on extension tests of a couple of new-pool discoveries on the northwest edge of this 33-year-old field. The field will be the scene of additional drilling this year to the new 7 and 8 Miocene pools in the northwest block.

Another area in the basin slated to see continued drilling activity is at Yorba Linda. Operators there are active in extension tests involving the Repetto and Carlton pools. The Repetto was discovered in 1954 and the Carlton last year.

Two other regions which could see exploratory drilling involve municipally owned offshore acreage in the basin. One is the Los Angeles Harbor area and the other is at Hermosa Beach on Santa Monica Bay.

The situation at the harbor is up in the air at this point. The city council, mayor, harbor department, and others are involved in a hassle over leasing policies and until it is straightened out, little drilling will be done.

This acreage is particularly attractive as it adjoins the huge Wilmington oil field.

At Hermosa Beach, operators, including most of the majors, are submitting bids for developing that small beach city's tidelands on the same type of deal Signal Oil & Gas Co. has with neighboring Redondo Beach.

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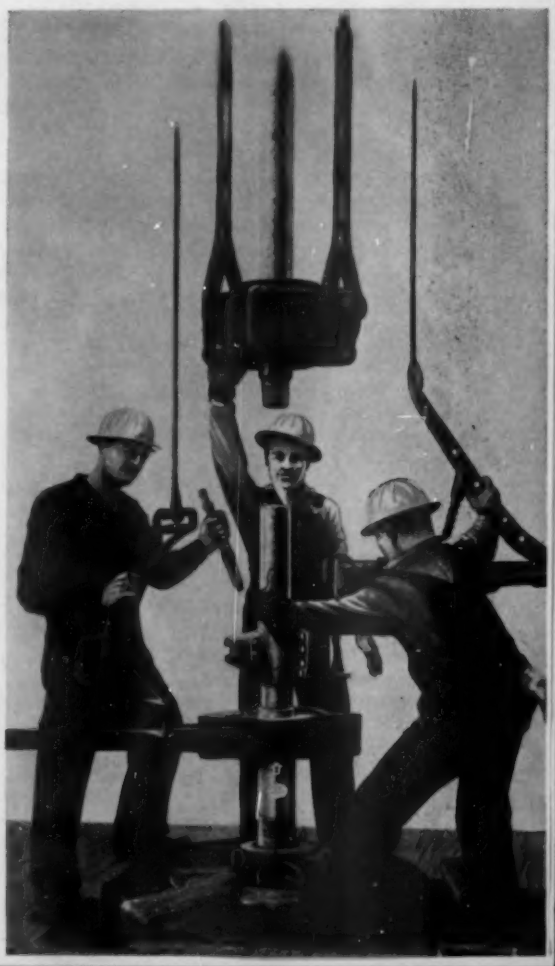

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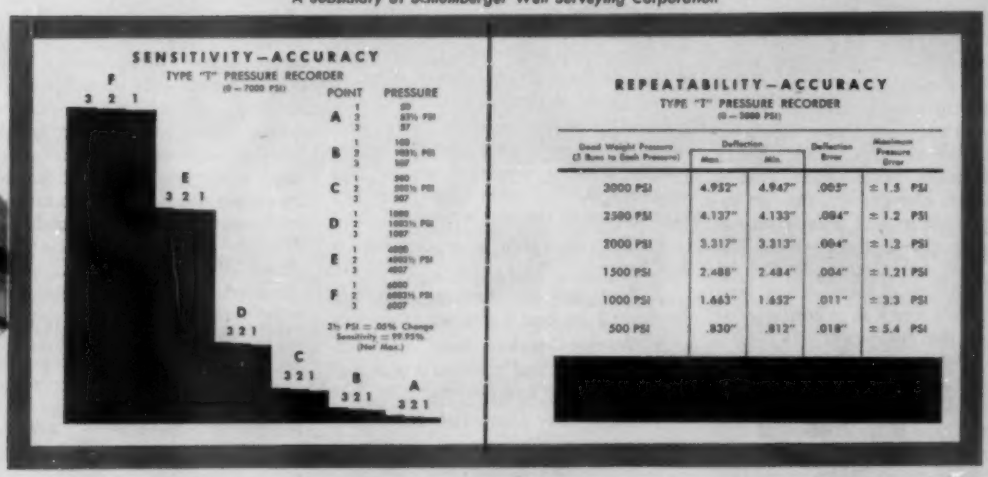

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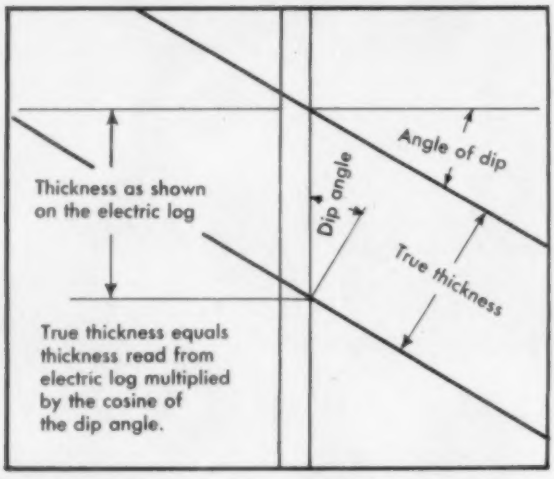
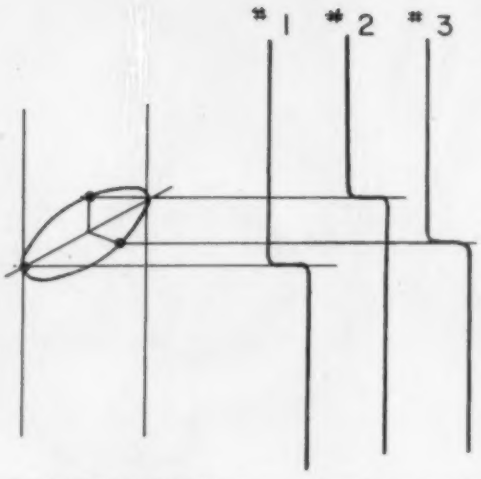

Thickness as shown on the electric log
Dip angle
Angle of dip
True thickness
True thickness equals thickness read from electric log multiplied by the cosine of the dip angle.

IN BEDS WITH STEEP DIP, the thickness logged in the bore hole is much greater than the true thickness of the bed. Fig. 1.



DIP DETERMINATION from a dipmeter survey is simply the solution of the "three-point" method of determining a plane in space. Fig. 1a.

THE CONTINUOUS DIPMETER

. . . Its use—and abuse

This is the first of a two-part article. Part 2 will describe how to calculate results of a continuous dipmeter survey.

Part 1

by Jack Grynberg and M. I. Ettinger

THE dipmeter, especially the continuous poteclinometer monoguard electrode (CDM) dipmeter, is an excellent tool for both exploration and exploitation. Valuable data may be obtained from a dipmeter survey if it is properly and accurately interpreted. Companies should train more of their personnel to perform independent interpretation and computation of dipmeters or hire reputable consultants to do this work. There should be more cooperation among the dipmeter interpreter, the geologists, geophysicists, and petroleum engineers using the dipmeter data. The dipmeter data, of course, should be handled with strict confidence and regarded at all times as a confidential property of the company.

Any dipmeter results lying in a file can be recalculated using the approaches and procedures outlined in this paper. There is no doubt that this work could be gratifying in developing new prospects in the ever-increasingly difficult hunt for hydrocarbons; and the reappraisal might explain the reason for dry holes that could have been prevented. More dipmeter surveys should be run since it is the cheapest way to obtain a true dip and its direction without drilling two additional wells.

Abuse of the dipmeter . . . The main abuse of the dipmeter consists of not having this type of survey run when it is most needed. This abuse probably stems from the fact that not many people know the dipmeter principle. Only a few engineers and geologists realize what a dipmeter survey can accomplish. The other equally important abuses of the dipmeter are:

1. The dipmeter interpretation is too hasty.

2. Not enough marker beds are computed in one dipmeter.

3. Wrong marker beds are frequently picked and erroneous dips and their directions computed.

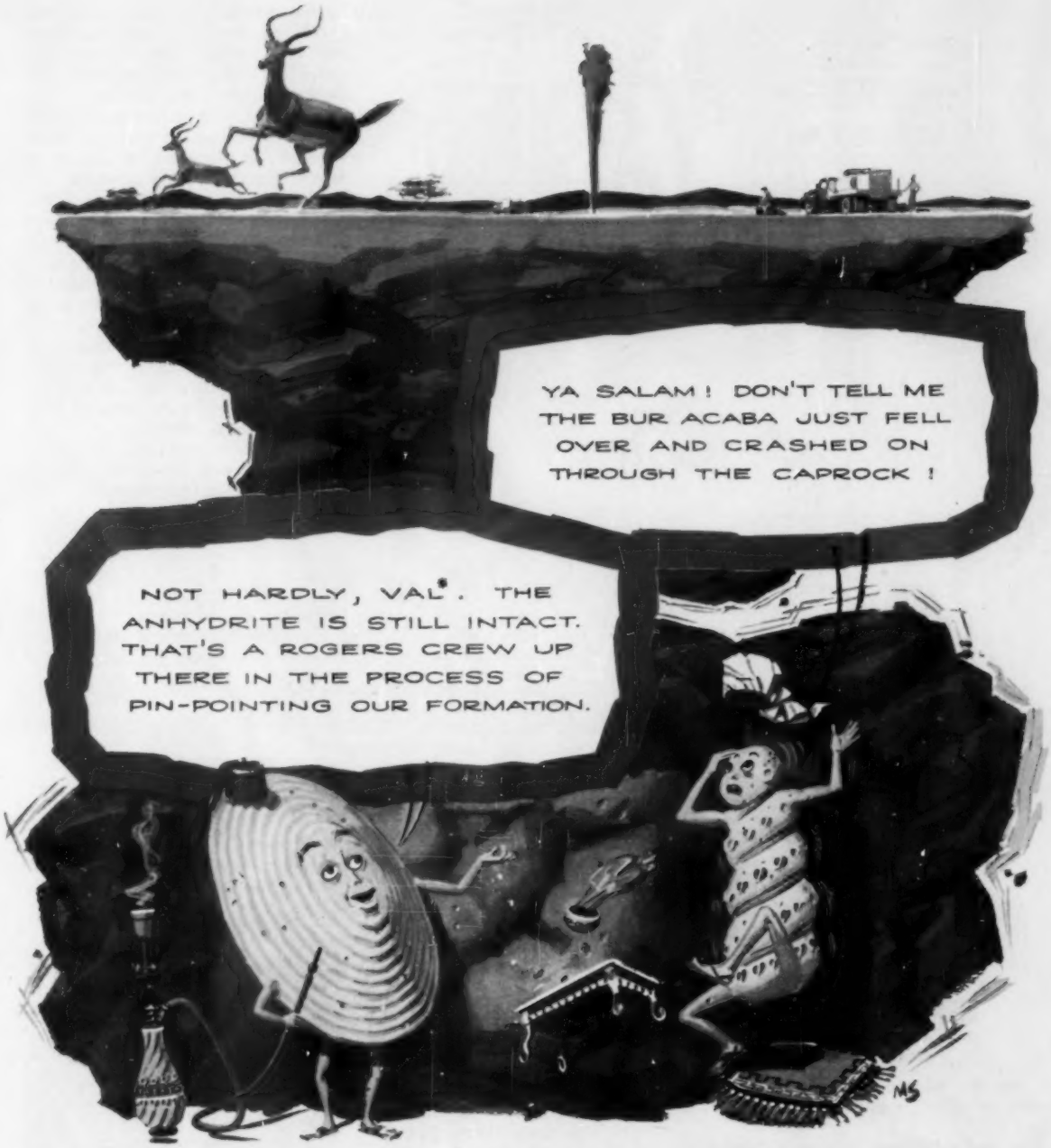
4. Dips are computed in wrong places.

5. Dipmeters hardly ever are correlated with the electrical surveys to determine the proper and continuous marker beds.

6. The computations are not double checked; therefore any errors that might occur are not eliminated.

7. There is hardly ever any coordination between the dipmeter interpreter and the project geologist.

As a matter of fact, the project geologist hardly ever unrolls the long dipmeter rolls to examine the quality of the curves. The writers have found in the past that the interpreter reported dips in a section where no marker beds were present or in sections where one or two of the resistivity curves did not function at all. Such negligence can be remedied only through closer cooperation and the ability of a project geologist or another trained person to check the results obtained by the dipmeter interpreter. If in several cases the interpreter proves to be erroneous because of the method used or because of his p e r s o n a l lackadaisical approach, there is no other choice but to replace him. A reliable consultant on dipmeter interpretation could very easily save the company a worthwhile sum of money by supplying the company with reliable results which will either prevent the company from drilling an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* *VAL is valvulinella one of the micro fossils in the oil bearing Jurassic rocks. The other fossil shown is Orbitolina. Ammonite is in background.*

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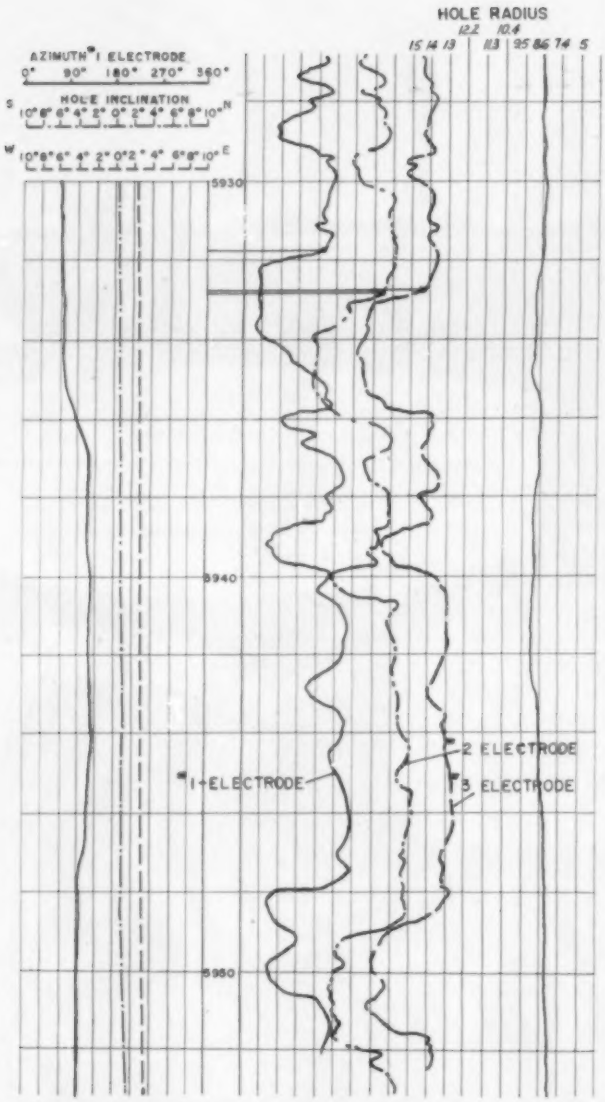


DIPMETER SURVEYS give continuous readings on the azimuth of the No. 1 electrode, hole inclination, hole radius, and correlation points. With these data, the dip of the formations can be easily calculated. Fig. 2.

offset dry hole, or encouraging it to drill an offset producer.

Dip and strike data . . . A dipmeter is a downhole instrument recording a set of curves from which basic data is obtained to compute dips and strike of strata penetrated by a corehole.

The operator can apply this dip information to exploration, development, and production of hydrocarbons. The strike can be easily obtained from the dip direction since it is perpendicular to it.

There are several types of dipmeters currently in use, but all operate along the same principles. Similarly, several methods for interpretation of dipmeter data are used; all of these methods solve a three-point problem and correct for borehole inclinations. This paper will mention the various types of dipmeters and their interpretations but will limit the discussion to only two types of interpretations. In addition, an attempt is made to define the factors that govern the accuracy of dipmeter computations and to suggest ways to avoid errors that occur in the course of interpretation. Emphasis is placed on the use and application of dipmeters as well as their abuse.

Surveys now in use . . . Each of the different types of dipmeters measures a certain physical property of strata penetrated by the borehole. These physical properties may be measured by the various dipmeters, which are: resistivity, spontaneous potential (S.P.), scratcher (section gage, caliper) MicroLog (TDM), and monoguard electrode (Microlaterolog, CDM).

The first two are noncontinuous and all the curves are recorded simultaneously at a number of interrupted levels. The last three types of dipmeters are continuous, thus recording all the curves any desired distance without interruptions. Due to changes in physical characteristics of the various strata, the top and bottom of these beds can be detected from the dipmeter curves.

The main objective in assuring a reliable interpretation of the survey is to obtain a sharp contrast with the three dipmeter curves when passing from one bed to another. Such a contrast will henceforth be referred to as a **marker bed.** When the beds are dipping in a certain direction, each one of the three electrodes, which produce the three curves, will encounter the top or bottom of a bed in question at a different depth. This difference in depth can be easily determined by correlating the three curves; thus, the vertical displacement of two corresponding points with respect to a third one in the plane of a bed can be scaled off. The rest of the data required, such as the hole diameter, azimuth of the No. 1 curve, east or west and north or south hole inclination components, is read directly from the dipmeter log.

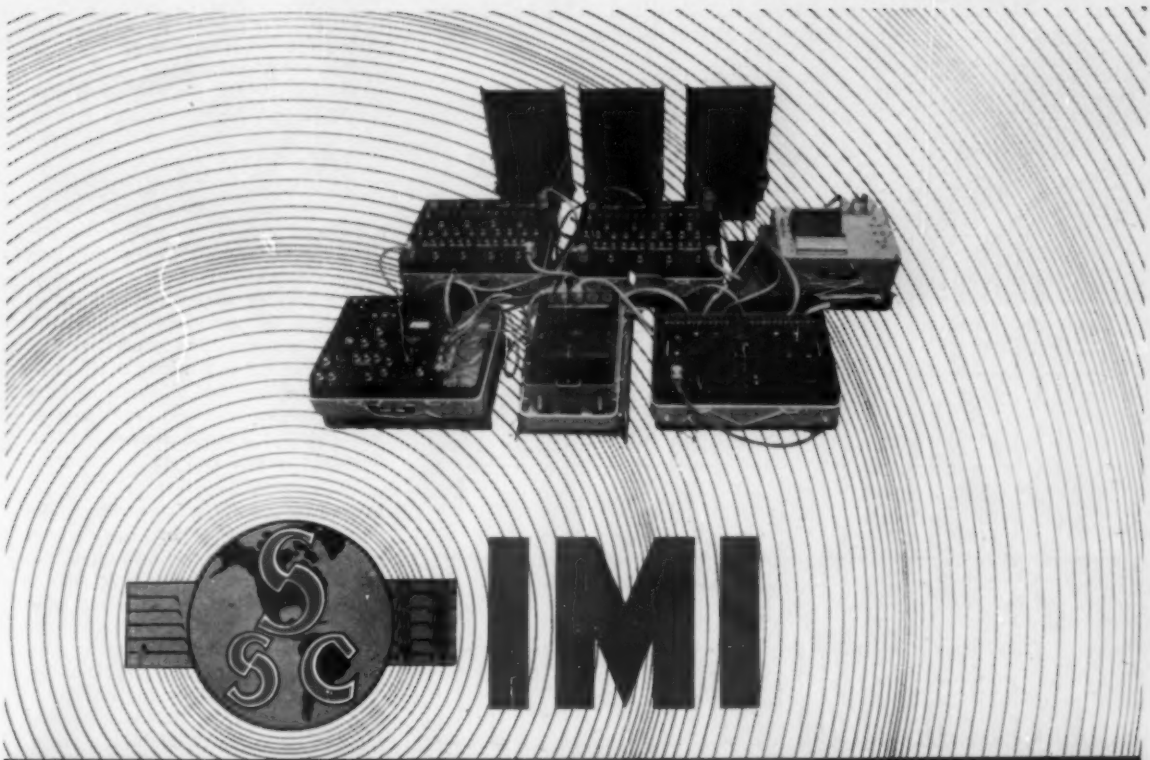
Application . . . It is very important to know the dip and strike of the subsurface beds in exploration and develop-

THE AUTHORS

JACK GRYNBERG **M. ETTINGER**

Jack Grynberg is owner of the firm, Jack Grynberg & Associates, consulting petroleum and geophysical engineers, Denver. He is a graduate of Colorado School of Mines with a degree in Petroleum Engineering and took graduate work there in geophysical engineering. He worked as a research engineer in the research and development department of Continental Oil Co. at Ponca City. Together with Dr. B. J. Pirson of University of Texas, he has been conducting 2-week logging schools throughout the country.

M. I. Ettinger is a geologist and geophysicist with the firm of Jack Grynberg & Associates. He, too, is a graduate of the Colorado School of Mines, majoring in geophysical and geological engineering.



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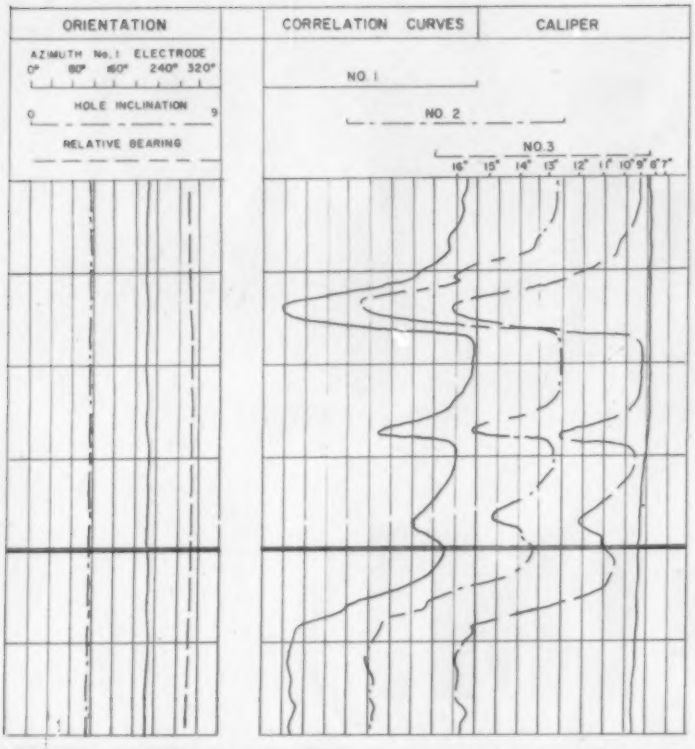


HERE IS A PORTION of the newest continuous dipmeter, the monoguard electrode or Microlaterolog dipmeter. Fig. 3.

ment, as well as in petroleum reservoir engineering. The exploration geologist wants to know where to stake an updip location if an oil water contact is found in a wildcat well; he desires this information even if all reservoirs penetrated are water bearing. The determination of true formation thickness, faulting, and unconformities is likewise important in planning further exploratory or development drilling.

In relatively steep dips the formation thickness as recorded by the electrical log is much larger than the actual true thickness. In order to determine the true thickness, the dip of the formation in question must be known. The true formation thickness (Fig. 1) can be obtained by multiplying the apparent thickness read from the electric log by the cosine of the dip angle. For instance, if an apparent formation thickness determined from the electric log is 100 ft. and the dip is 60°, the true thickness will be only 50 ft. If the angle of dip is only 30° the true thickness will be equal to 86.6 ft. If no dip is encountered, it is likewise important to know that a top of either an anticline or a syncline has been reached. The dipmeter data may also be used to check or supplement available geophysical information.

The development geologist and petroleum engineer are interested in all of the above aspects. In addition, they would like to know the type of structure that is present and the magnitude of dips and their respective directions. In case of a gas-oil contact indicating the presence of a gas cap, it is important to know where to stake a location. Similarly, it would be important to know an updip location if a gas injection program is to be initiated at a later date. Also, in directional drilling, especially in case of sidetracking a well when steep dips are encountered, it is important to know the magnitude of encountered dips and their respective directions. For the reservoir engineer, all of the above characteristics are important in determining the reservoir performance and thus, the field economics. In case of faults, additional wells not on regular spacing might have to be drilled to drain the separated reservoirs adequately. If the reservoir is faulted, a secondary-recovery program will have to be planned accordingly.

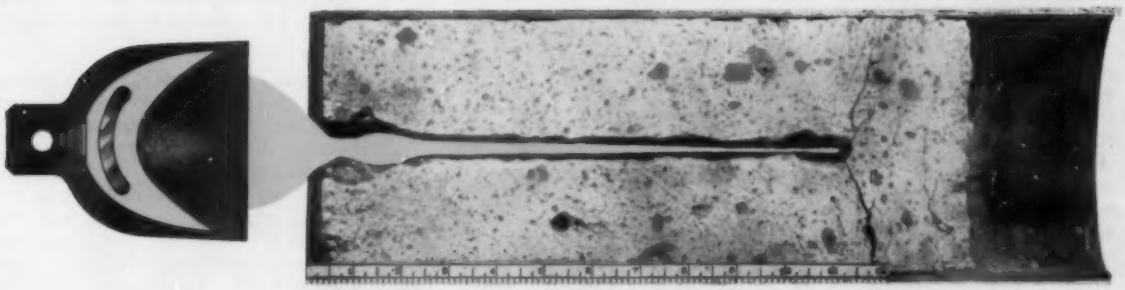
All of the foregoing information is necessary for well-balanced exploration, exploitation, production, and secondary-recovery programs. This can be obtained only if these programs are planned well in advance and the dipmeter surveys run in wildcat development wells from the start.

In addition to the above applications, the continuous MicroLog and monoguard (Microlaterolog) dipmeter may be used qualitatively in all cases as a substitute for the MicroLog and the Microlaterolog to indicate porous and permeable reservoirs. The geologist or petroleum engineer in charge of the well may request the service company's truck operator to install a scale on one of the recorded resistivity curves for no extra charge. Then the continuous TDM or CDM dipmeters may be used quantitatively to determine the per cent porosity of logged reservoirs. This procedure will save money for well operators by eliminating the need for a MicroLog or a Microlaterolog survey; the savings will pay for a good portion of the dipmeter service charge.

Instrumentation . . . To determine the dip and strike of a plane, three points of that plane, not along a straight line, have to be established. In order to define this plane, the engineer must know the horizontal position of the three points, their orientation, and their relative vertical displacement. Thus, each type of dipmeter must contain certain devices that will provide the data necessary to establish a plane; then the dip and strike of the beds may be computed.

A dipmeter consists of a set of three curves. These are recorded on the right side of the dipmeter log, and describe a plane by having each of the curves determine the position of one point of the plane in question, Fig. 1a. The three curves are 120° apart, constituting 360°, or a complete circle. The set of three curves in noncontinuous dipmeters consists of three spontaneous-potential curves or three resistivity curves. In continuous dipmeters, the set comprises three caliper curves, three MicroLog curves, or three monoguard electrode (Microlaterolog) curves. The relative horizontal positions of the three points from corresponding three curves are determined by the radius of the borehole. The hole diameter is recorded by the caliper log, run simultaneously with continuous dipmeters. In noncontinuous dipmeters the hole diameter is obtained from a section gage log run separately.

In a bedding plane the vertical displacement of two corresponding points of a marker bed with respect to a third point can be read directly from the three curves of the dipmeter log. The orientation of these points is to the magnetic north. Since the curves are 120° apart, the orientation of one of these curves determines the orientation of the other two. The curves are numbered from left to right No. 1, No. 2, and No. 3, and are recorded



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from electrodes numbered correspondingly.

In the noncontinuous spontaneous potential and resistivity-type dipmeters, the orientation is recorded by a photoclinometer. It takes a picture at a given level showing the position of electrode No. 1 relative to a magnetic needle indicating the magnetic north. The photoclinometer record is not continuous; and the pictures have to be taken at two or three intervals within a level so that an average or an interpolated value can be used for computations.

In the more recent or continuous dipmeter surveys a teleclinometer is used to record the orientation of the No. 1 curve. A set of two magnetometers, located at right angles to each other, are kept horizontal. These two magnetometers consist of a high-permeability alloy, inserted in two coaxial coils. One coil is fed with a constant alternating current. The current induced in the second coil is a function of the alloy's magnetic saturation. The earth's magnetic field affects the saturation of the alloy according to its orientation. The position of the magnetometer is fixed with respect to electrode No. 1, from which curve No. 1 is recorded. Thus the orientation of the No. 1 electrode can be recorded continuously. Since the No. 2 and No. 3 electrodes are at a fixed distance from the No. 1 electrode, their respective orientations are at the same fixed distance from the recorded orientation of the No. 1 electrode.

Because boreholes are very frequently nonvertical, the inclination of the hole should be recorded. This enables the engineer to correct the computations of dip and its direction for the amount of hole drift. In the noncontinuous, early type of dipmeters, the hole inclination was also measured by the photoclinometer. A picture was taken of a magnetic needle and a ball on a graduated, curved glass at two or three intervals within a level. The position of the ball indicated the azimuth and the magnitude of the borehole inclination.

The teleclinometer records continuously the hole inclination by using two pendulums that swing in planes perpendicular to each other. The angle of rotation of each pendulum is proportional to the component of the hole-drift vector in the direction of the pendulum movement. Thus, the hole drift or hole inclination is resolved into two vectors perpendicular to each other. The vectorial addition of these two components determines the angle of the hole drift and its orientation. The orientation of the planes in which the pendulums swing can be determined by the orientation of the instrument (resolver out) or can be fixed to coincide with the north-south and east-west directions with respect to the magnetic north (resolver in). The latter arrangement is currently in use (Fig. 2). At the two ends of the dipmeter instrument, spring guides are designed to keep the instrument along the axis of the borehole.

The newest continuous dipmeter in use is the CDM poteclinometer type; this is frequently known as the monoguard electrode or Microlaterolog dipmeter. A section of this dipmeter log is presented in Fig. 3. Each of the three pads is constructed to assure that the potential of the only central electrode is equal to the potential of the surrounding pad. This develops a potential difference of zero, creating a current focusing effect, which enormously increases the accuracy, distinction, sensitivity, and detail of recording the three resistivity curves. The azimuth of the No. 1 electrode and the azimuth and magnitude of the borehole inclination are recorded by using a different principle from that used by the TDM teleclinometer dipmeter. This makes the former more sturdy and more reliable. The azimuth of the No. 1 electrode is recorded by a rotary potentiometer whose wiper arm is connected to a compass needle. The TDM dipmeter has an azimuth scale with 10 divisions of 36° per division; however, the CDM dipmeter has 9 divisions of 40° per division. The angle of borehole inclination is recorded directly by the poteclinometer; it does not require a mathematical solution. It is recorded from a magnetic weighted pendulum connected to a potentiometer arm. The azimuth of borehole inclination is also directly recorded, using the principle of an unbalanced cylinder whose rotation is a function of the bearing.

Comparison of Dipmeters

The continuous dipmeters supply a complete continuous downhole record while the noncontinuous have only an interrupted partial record, frequently covering the unimportant sections and omitting the crucial ones. A complete record of all measurements along the total depth of the hole enables the interpreter to select the most reliable markers for dip computations; and it is possible to double check the final answers by comparing them with results obtained from adjacent markers. The continuous dipmeter supplies the drilling contractor and well operator with a continuous hole-drift record and a continuous hole caliper (section gage) record of the well. The latter service has a separate extra charge in the noncontinuous dipmeters; however, there is no extra charge in the continuous ones.

Accuracy and costs . . . The continuous dipmeters are far more accurate than the noncontinuous ones, much faster in surveying the well, and cheaper. The caliper-log continuous dipmeter is an exception to the rule as far as accuracy is concerned. The accuracy of dips computed from the S.P. dipmeter is approximately ±10°; from the noncontinuous resistivity dipmeter and continuous caliper dipmeter ±8°; from the TDM continuous MicroLog dipmeter ±3°; and from the CDM continuous monoguard electrode dipmeter ±1.5° provided the interpretation is correct.

The slowness of the noncontinuous dipmeter is due to the logging technique. When each level is logged, a procedure of first taking a picture with the photoclinometer, then logging, then taking another picture with the photoclinometer has to be followed. Sometimes an additional photoclinometer picture is taken in the middle of the logged interval.

The continuous dipmeters are cheaper. In a noncontinuous dipmeter there is a separate depth charge of $0.05 per foot and a logging charge of $0.03 per foot for the caliper log. The operational charge of the noncontinuous dipmeter is $225 compared with $200 for the continuous dipmeter. There is a $50 per level charge for the noncontinuous dipmeter compared to a continuous dipmeter logging charge of $0.10 per foot. Thus, for the price of every noncontinuous level, 500 ft. can be logged continuously. The depth and setup charges are the same for both continuous and noncontinuous dipmeters. In an 8,000-ft. hole where 5,000 ft. are logged by a continuous dipmeter instead of taking 10 levels with a noncontinuous dipmeter and logging a section gage for a cumulative distance of 500 ft. (50 ft. per level), a savings amounting to $440 will be realized.

Based on the above-described deductions, it is obvious that the noncontinuous dipmeter has outlived itself.

Accuracy of Interpretation

There are a number of places in computations of a dip and its direction where an error can be made. Fortunately the possible instrumentation and recording error is extremely small in the continuous dipmeters and therefore may be completely discarded. Not so in the case of the noncontinuous S.P. and resistivity dipmeters and the continuous caliper-log dipmeters. There, no correction can be made for the instrumentation and re-

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cording error. It therefore may be considered one of the disadvantages of that type of dipmeter. The accuracy of recording may be substantially increased by calibrating the dipmeter resistivity scales to a scale most sensitive in penetrated formations.

Frequently no marker bed may be observed and no bed boundaries distinguished if a scale of 0 to 25 ohm-m. is used. If, however, a scale of 0 to 10 ohm-m. had been used in the same case, additional reliable marker beds could have been selected and boundaries depicted with greater accuracy. Thus the recording calibration of a dipmeter log to determine the most suitable scale is an important factor in obtaining a proper log with which to work.

Marker beds . . . The most common errors are the human variety. These occur in the interpretation of the dipmeter and computation of its data. Among them, the most frequent is the error of selecting marker beds. Only markers representing continuous beds should be chosen. They may be determined either from experience in the area under consideration, or preferably by correlating the dipmeter log with an electric or microsurvey. This marker should then be correlated with other electrical surveys available in the area. This may also be done on a mass-production basis by correlating a group of marker beds simultaneously.

In general a good continuous marker bed has very sharp distinguishable boundaries in either the top or the bottom of the bed. A boundary of a shale or low porosity streak in the middle of a bed is always unreliable. This holds true even if the contrast is sharp, since it represents lithology rather than structure. A marker indicating a boundary between sandy or limy shales and shale is very risky; this type of marker, should not be used unless it has been confirmed by upper or lower marker beds to assure repeatable and reliable results. In thin interbedded beds the noncontinuous dipmeters usually record poor, unreliable markers.

Fractured reservoirs, particularly limestone and dolomite, and crossbedded sandstone reservoirs, usually contain marker beds representing erroneous dips. The dips from these marker beds represent the combined components of the bed's dip and that of crossbedded or fractured systems. However, not all marker beds in crossbedded or fractured horizons are affected by the crossbedding or the fracturing. The unaffected marker beds represent the actual dip and direction of a bedding plane; and the results of several adjacent marker beds are extremely close or equal for all practical purposes. Crossbedded formations are usually known in a given area. However, fractured reservoirs are quite frequently unknown.

There are some unexplainable reasons why a marker bed is unreliable. It is a simple procedure to eliminate all of the unreliable marker beds, whether they are affected by crossbedding, fracturing, or are just stray. Always compute two or three additional markers in order to choose the representative one and double check the reliability of the calculated results. If the final results obtained from each of the three markers are repeated, the answer is definitely reliable. If, however, the result from one of the three adjacent marker beds disagrees with the rest, it is eliminated; then either the average or the more representative value of the remaining two is chosen. Thus, if only one marker bed is selected for computation of dip and its direction, the final results may or may not be reliable.

Erroneous marker beds . . . The importance of performing several computations can be seen by studying Fig. 2; the log shown is section of a TDM continuous dipmeter log taken in an actual well. There are three marker beds in this section. One of the markers is located at 5,932 ft., one at 5,940 ft., and the third at 5,949 ft. In the upper and the lower markers the corresponding points on No. 2 and No. 3 curves are approximately the same vertical distance below the corresponding point on the No. 1 curve.

Since the azimuth of the No. 1 electrode does not vary to a great extent along the logged interval, it can be assumed that the two markers will represent approximately the same dip and strike. The marker bed at 5,940 ft. has the corresponding points on the No. 1 and No. 3 curves at approximately the same elevation whereas the corresponding point on the No. 2 curve is lower. Therefore the marker bed at 5,940 ft. will have a different dip than the marker beds at 5,932 and 5,949 ft.

The computed results obtained from the marker bed at 5,940 ft, provide a distorted picture since they differ enormously from the results obtained from the upper and lower marker beds. The dip of the upper and lower marker beds are equal for all practical purposes. It is therefore reasonable to assume that the dip and its direction of the upper and lower markers represent the true value of the section in question. The results derived from the middle marker are erroneous.

"The accuracy of dipmeter computations decreases with the decrease in the angle of the dip. In small dips where the accuracy is lowest, a good, distinguishable marker with sharp correlating points is of great importance."

Another approach is currently in use that helps eliminate any erroneous marker beds present. This approach consists of overlaying a transparent copy of a dipmeter log over another copy of the same log. The interpreter selects an interval of 10 ft. to work with. He subsequently correlates the No. 2 and the No. 3 curves with the No. 1 curve, and measures with respect to the latter curve the average vertical displacement within the 10-ft. interval.

This method is much faster and therefore used by service companies. Its great disadvantage is that any erroneous markers present within the 10-ft. interval are not eliminated but averaged. Thus the final answer is erroneous. The other disadvantage of this method consists of measuring the vertical displacement with the dipmeter scale which is not sufficiently precise. It is extremely important to read off as exactly as possible the precise vertical displacement represented by the three curves. If a mistake of 1/30 of an inch is made with a scale, there could be an error of several degrees in the magnitude of dip and an error of over 15° in the dip direction, depending on other prevailing conditions. For that reason, the authors recommend using a scale with 60 divisions to an inch to measure the precise vertical displacement.

In order to assure greater accuracy and eliminate possible human errors, it is advisable to measure and record the vertical displacement of all marker beds, the azimuth of the No. 1 electrode and hole inclination data for each marker in 1 day; then repeat the same procedure 2 days later and compare for possible discrepancies that should be corrected. This procedure, though tedious, eliminates any probable human error in obtaining basic computational data. Unfortunately, it is never followed by the service companies' interpreters.

The computational error may be eliminated by double checking the calculations as well as the final results using two independent methods. These will be described in Part 2 under "Methods of Interpretation" that will

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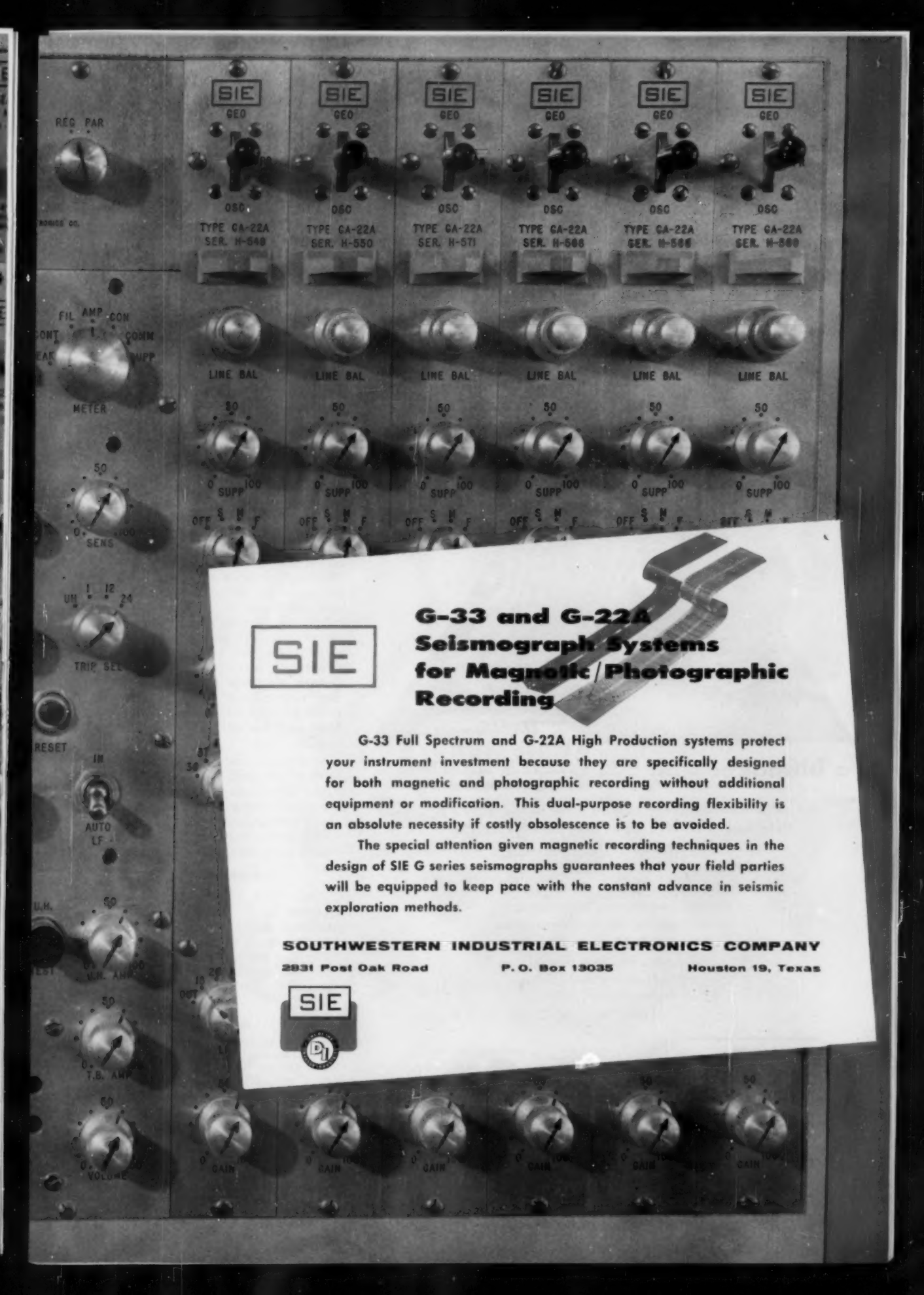

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appear in The Oil and Gas Journal at an early date.

The accuracy of dipmeter computations decreases with the decrease in the angle of the dip. In small dips where the accuracy is lowest, a good, distinguishable marker with sharp correlating points is of great importance. A minor mistake in correlating the three curves may result in a considerable error of dip and its direction. The smaller the angle of dip, the greater is the bore inclination effect on a possible error, and vice versa. The per cent error in small dips is naturally greater than in larger ones.

An error in hole size will not affect the direction of dip but will result in an error in the magnitude of dip. In one actual case a 7.5° dip was computed for a 7-in. hole size. Using the same basic data but increasing the hole size, the following results were obtained:

Hole Diameter (inches)	Angle of Dip (degrees)
7	7.5
9	6.0
12	4.5
14	3.75

The magnitude of dip will decrease if computations are performed for a hole size larger than the actual. Similarly, the inverse will apply. Needless to say, this is a sufficient reason to insure accurate hole-diameter data.

There are a number of older noncontinuous dipmeters in company files which were originally run without a section gage. Formation dips and their respective directions were computed from these dipmeters on an assumption that borehole size equaled bit size. This of course is not always the case. Today there are probably a number of recent wells drilled in the general area in which MicroLog surveys with microcaliper curves were run. It is, therefore, possible to observe in those recent wells the deviation of hole size from bit size. This information can be extrapolated for corresponding formations to the well in which the noncontinuous dipmeter was run. If there is a substantial discrepancy between bit size and hole size, the dipmeter data should be recomputed in view of the new evidence.

By using the mechanical device method to be discussed under "Methods of Interpretation," (Part 2) an error may occur in the instrumentation if it is not frequently calibrated. The largest error in this method of interpretation is probably human. This error occurs in the overhasty introduction of dipmeter data into the instrument, as well as in the improper reading of scales. A person using the mechanical device does not go through any steps requiring an intimate knowledge of the local and regional geology. As a result he is not likely to detect any errors that could possibly occur.

In summary one may state that the methods described in this paper and Part 2 that follows are by far the most accurate, assuring a proper and reliable dipmeter interpretation. By following these methods, any possible human error may be easily detected.

Acknowledgment

The writers wish to express their gratitude to E. B. Wasson, Rocky Mountain division manager of Cosden Petroleum Corp. for suggesting the title of this paper, to Horst Obradovich for drafting the figures, and to Mrs. Shirley Roth for typing the manuscript.

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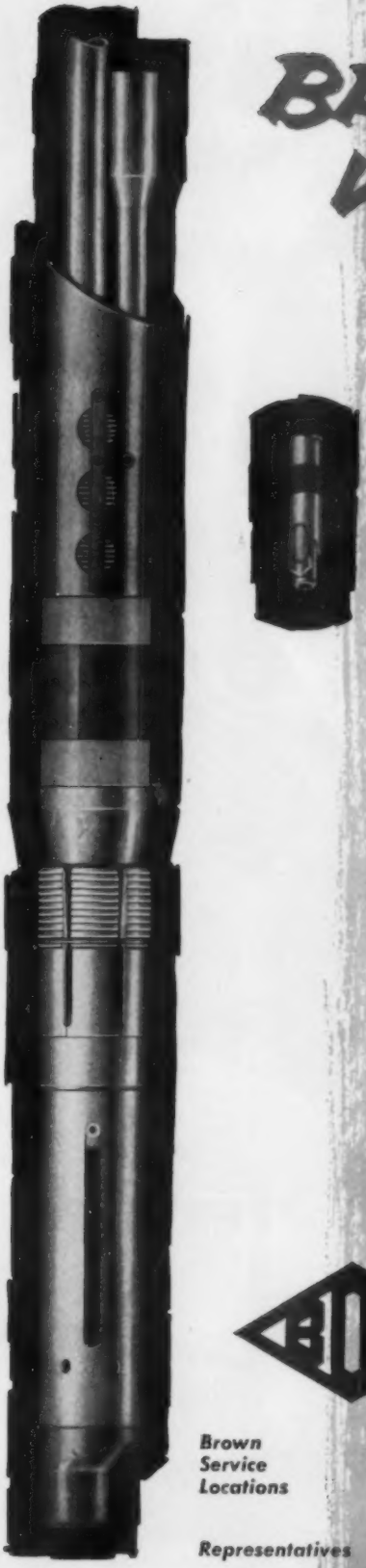

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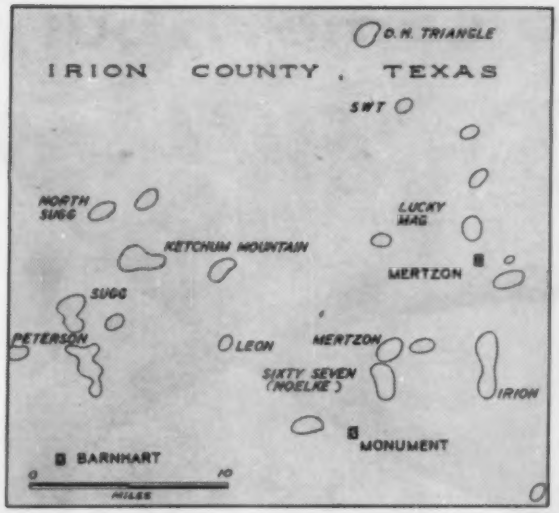
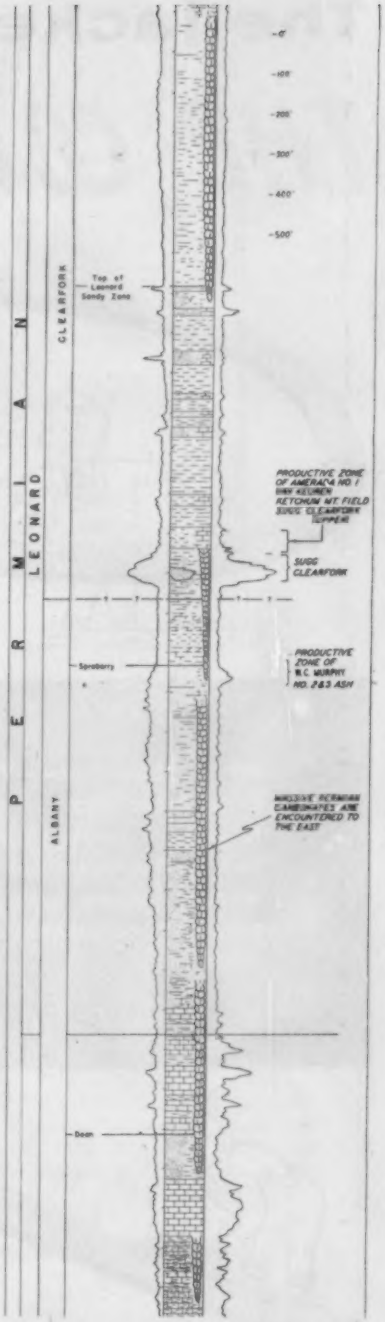


IRION County in West Central Texas is in the midst of a spirited exploration and drilling program. During 1956 there were 14 successful wildcats. Fig. 1.

ONE of the main pay zones in Irion County is the Clear Fork. In addition to sand production, there is reef production in the county. (Type log courtesy of San Angelo Geological Society). Fig. 2.



"Condemned" County Sets West Texas Pace

by W. E. Bivens

MORE oil has been discovered in Irion County, Texas, in the last 2 years than in all its previous history. Still, the county is only sparsely drilled.

Irion has about 9,000 ft. of sediments on the eastern side and about 12,000 ft. on the west.

At the outset this county was condemned by the experts. Some of the more prominent geologists theorized that between the Central Basin platform and the Eastern Shelf was a vast shale basin in which no porous or potentially porous rocks were deposited. A few unenlightened people drilled some holes anyway and established shallow production in 1928. Although several small fields were found over the years, none of them was a real money marker. The permeabilities were generally low for the old completion methods; there was a considerable transportation problem, and the price of crude was about one-third of today's.

Located at the edge of the Eastern Shelf, Irion County has been little known and little explored. Company district men have found it on the edge of their district—and wished the other district had it.

It doesn't take long with any valid exploration method to see that Irion is full of anomalies. Some of the recent discoveries have been based on surface indications noted in the outcrops many years ago. There are some features easily visible from the air, even from regular commercial flights. There are inliers in flat fields. The evidence of structures has been there for those who would see.

Subsurface control has been widely scattered with occasional small bunches of points on shallow horizons. Correlations are still subject to some disagreement. Those who bring their nomenclature from the Bend flexure section often have difficulty trying to tie in with those who bring the Glass Mountain section names across the basin. This makes for some confusion in discussing the simplest problems.

Geophysicists also have their problems. There are few velocity data. Also the facies changes have led to many wrong interpretations. The low-velocity sand bars in the Clear Fork have caused some promising areas to be dismissed as low. As may be noted in Fig. 2, the limestones in the Wichita-Albany and Clear Fork were first deposited in local areas and later became widespread. This gives a sort of upside-down reef effect. Although the greater amounts of lime are generally to the east, in specific areas this does not always hold true. The seismic records in such areas sometimes show a rather flat top of Clear Fork with the lower picks coming in successively sooner as the line moves into an area of earlier lime deposition.

The **Grayburg** is present in the western part of the county only. It first produced in the Bingham 1 Sugg, which was completed as a 14-bbl. per day pumper. More prolific Grayburg wells are now being completed with the aid of fracturing. This section should produce in areas of Irion as it does in Crockett County.

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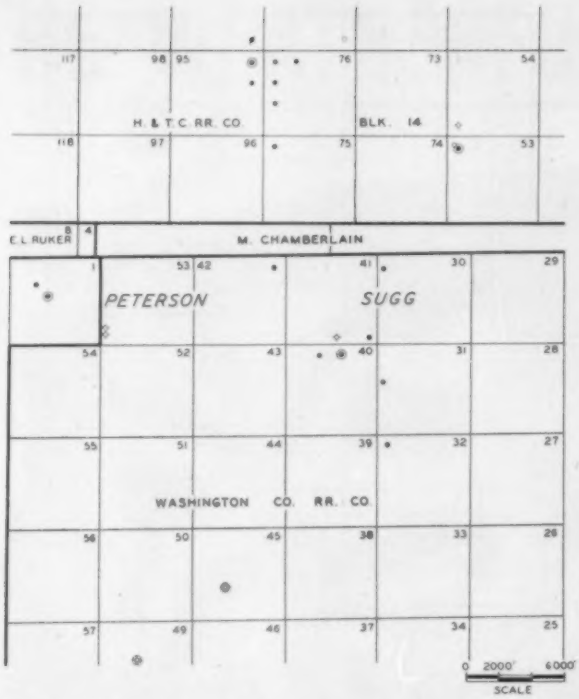
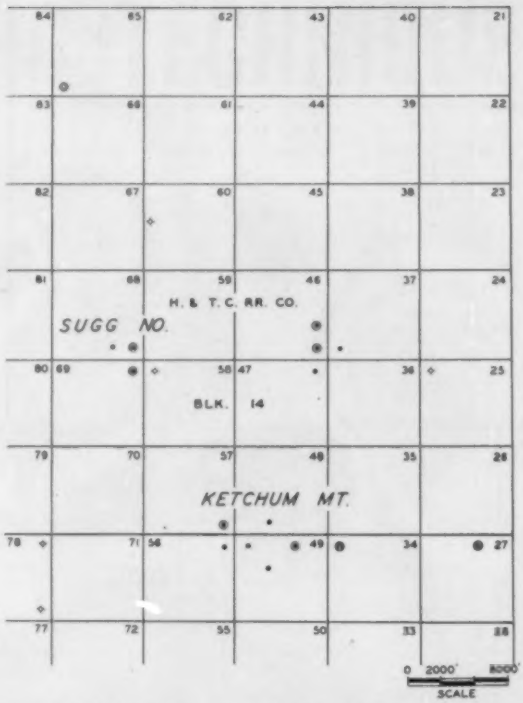


SUGG FIELD is a large surface structure with production on each end of the anticline. (Base maps courtesy of Midland Map Co.). Fig. 3.



THESE FIELDS produce from the Grayburg, Clear Fork, and Spraberry. Production is related to porous zones rather than to structure. Fig. 4.

Probably a good way to develop Grayburg production is to drill lots of cheap holes. It's hard to see the permeability from the top of the ground.

The **San Angelo** sand is probably the best money maker in the county at this time. Atlantic Refining Co.

THE AUTHOR

The author is a petroleum consultant and independent oil producer at San Angelo, Tex. He received his B.A. in physics and geology, B.S. in geology, and M.A. in geology and petroleum engineering from University of Texas. Bivens formerly worked as geophysicist for S. E. I., geologist for Sun Oil Co., and chief geologist for George W. Strake.

He was editor of the field-trip guide book for Central Mineral Region, Kerr Basin, Balcones Fault Zone, and Rio Grande Embayment published by the San Angelo Geological Society. He was an official delegate to the recent International Geological Congress, and is president of the San Angelo Geological Society.

SOME FIGURES AND FACTS ON IRION

Cumulative production through 1956, bbl.	1,037,046
Cumulative production through 1955, bbl.	667,919
Daily average production, 1956, bbl.	1,041
Daily average production, 1955, bbl.	179

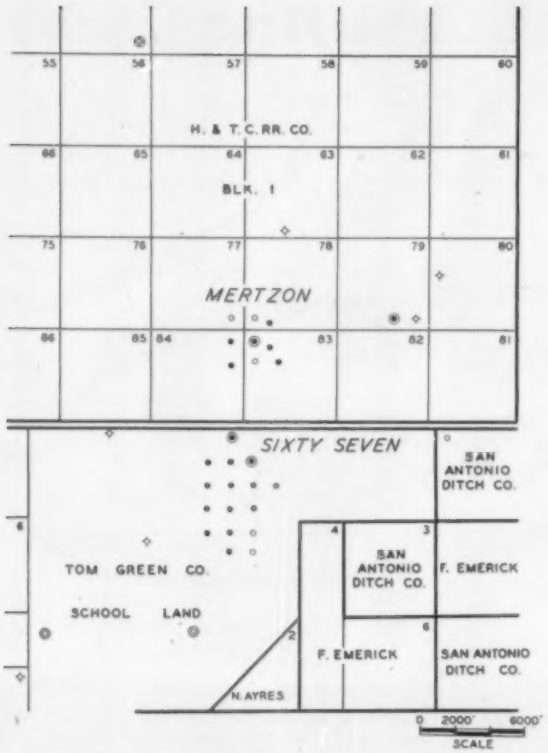
Two fields have been opened this year:

McIntire (Clear Fork)
Nathan Miller (Biggs lime)

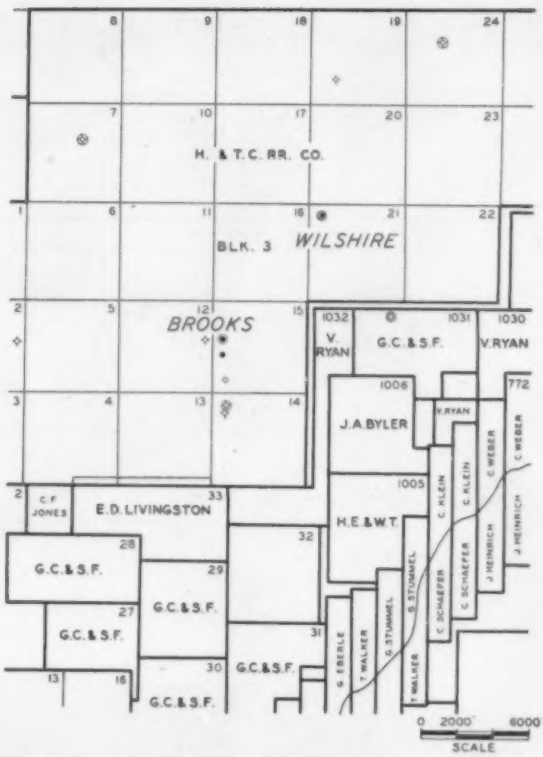
It will be noted that the 1956 production is nearly six times the 1955 production. Also the 1956 production is more than half the cumulative production to the end of 1955. The 1955 production had been about 10 per cent of the cumulative production to the end of 1954.

1956 Irion County Production by Fields

Field—	Barrels	Field—	Barrels
Arden	5,831	Mertzon (Clear Fork, lower)	4,310
Brooks (Wolfcamp)	7,305	O. H. Triangle (Canyon)	444
Brooks (Strawn)	14,437	O. H. Triangle (Wolfcamp)	1,362
Dove Spring	3,266	Peterson (San Andres)	5,071
Dove Creek, South	27,793	S. W. T. (Wolfcamp)	481
Dove Creek, South 6500	7,677	Sugg (Clear Fork)	62,646
Irion	1,384	Sugg, N. (Clear Fork)	15,400
Ketchum Mountain (Clear Fork)	56,680	Sugg, N. (San Andres)	4,611
Lucky Mag (Clear Fork, lower)	7,170	Sixty Seven	34,990
Lucky Mag (Divide)	6,766	**Total for 1956**	**370,127**
Mertzon (San Angelo)	37,005	**Total for 1955**	**65,498**



AT MERTZON and Sixty-Seven, the wells are shallow and inexpensive with good reserves. The deeper Strawn wells have larger reserves, but are of course more costly to drill. Fig. 5.



IT'S NOT ALL GRAVY in Irion County. At Brooks, the only dual completion in the county has a dry offset. Fig. 6.

and Sinclair Oil & Gas Co. are making excellent wells in Mertzon and Sixty-Seven fields. They can be drilled in a few days and afford quick payout and good reserves. Many of the wells flow after fracturing.

The **San Andres** carried shows in most of the early shallow holes. Reservewise it is outstanding, being some 500 to 700 ft. of broken permeability. C. P. Simpson found San Andres production in Peterson field and Pan American Petroleum Corp. produces San Andres oil at Sugg North.

The **Clear Fork** is a sand wherever it produces in Irion. It appears to be a series of barrier beaches or sand bars. Sinclair developed the first Clear Fork production in the county with the Sugg and Ketchum Mountain discoveries. Mertzon, Lucky Mag, Sugg North, and McIntire fields also produce from the Clear Fork.

The **Spraberry** is present in the western part of the county and has been found productive at Sugg and Ketchum Mountain. Nathan Miller field is a new discovery from the Biggs lime which is a local name for a 30-ft. lime section found about 500 ft. above the Dean sand, probably in the lower part of the Spraberry.

Wolfcamp discoveries have been made by Plymouth, Woodward & Co. and Tucker Drilling Co. In the only dually completed well in the county, the Woodward 1 Brooks in Brooks field, the upper producing zone is generally called Wolfcamp, although some call it Leonard. Wilshire field has gas in the lower Wolfcamp, and S. W. T. field has Wolfcamp oil.

Pre-Permian Zones

The Pennsylvanian section is here only about half as thick as the Permian. The divisions of the Pennsylvanian are not well defined, but the production generally considered upper Pennsylvanian is that in Dove Creek (Canyon) field and the lower zones in Lucky Mag and Brooks fields. These are sand reservoirs. The production generally considered as Strawn is the reef zone in the British-American 1 Noelke discovery, the Dove Creek South field, and Tankersly field pay zones. Strawn reefing should occur at several places in the county and should carry large oil reserves.

The Ellenburger has been productive in Irion but not commercially. Since very few Ellenburger tests have been drilled in the county, the possibilities are virtually unknown.

Fusselman pinchout? . . . To the west and northwest of Irion County are found thick Silurian, Devonian, and Mississippian beds. In northwestern Irion there is about 90 ft. of Devonian and about 100 ft. of Fusselman. About 8 miles southeast, these beds are missing. Somewhere in between will be found the updip pinchouts of these two reservoir rocks. This would seem a good place to look for an oil field.

Stratigraphic Traps

It seems likely that Irion must contain many stratigraphic-trap reservoirs. Flanking sands pinching out against structures and updip permeability pinchouts seem to fit in the geology of the area.

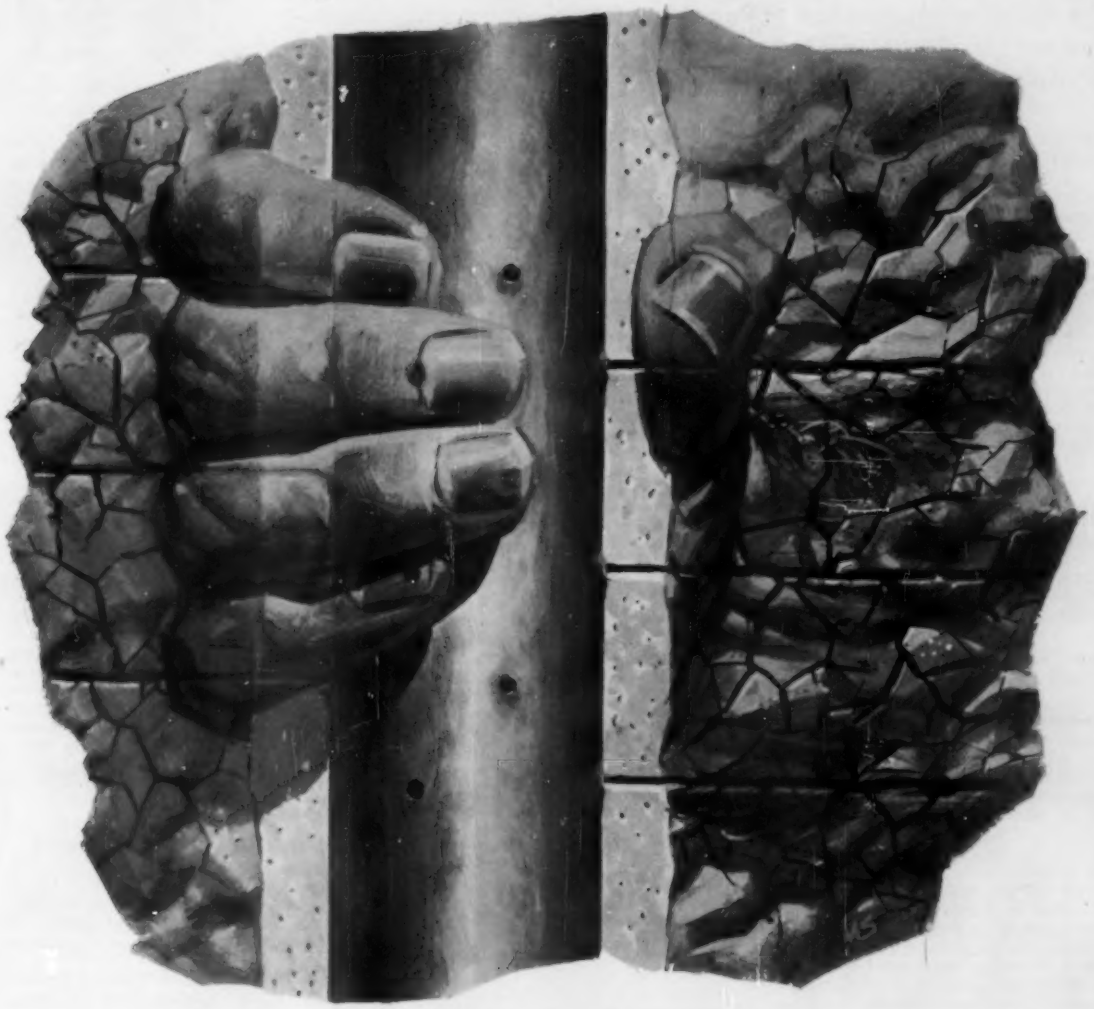
Drilling Problems

Those locations which fall on the low Cretaceous hills present the usual Cretaceous surface difficulties found in West Texas. Pits may have to be blasted and may be hard to seal. Large drill collars will take care of the hard lime. Typically circulation is lost in the Cretaceous, but this problem is solved by arranging for sufficient water to dry-drill this relatively thin section.

The red beds wash down at a minute or minute and a half a foot. The Castile salt section gives no trouble with salt-base mud.

Cutting the lower part of the section is similar to other drilling in the basin. **End.**

THE WEATHERFORD TECHNIQUE



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Selected Digests . . .

. . . of papers presented at the joint annual meeting of the American Association of Petroleum Geologists and the Society of Economic Paleontolgists and Mineralogists, St. Louis, April 1-4, 1957.

A History of the A.P.I. Recent Sediments Project

MARCUS A. HANNA, Gulf Oil Corp, Houston.

BETWEEN 1945 and 1947 the research committee of the A.A.P.G. under Shepard W. Lowman reviewed the needs for research in petroleum geology. In its final report this committee recommended research in sedimentology, and specifically proposed a study of the recent sediments of the northern Gulf of Mexico.

The A.A.P.G. had insufficient funds to support this ambitious project, so the American Petroleum Institute was asked to sponsor it as part of its program on fundamental research on the occurrence and recovery of petroleum. A "blueprint" was drawn up and sent to various institutions for study. The project was awarded in 1951 to the Scripps Institution of Oceanography, which has conducted the work since that time under the leadership of Dr. Francis P. Shepard.

Deltaic Sedimentation Along the Gulf Coast

FRANCIS P. SHEPARD, Scripps Institution of Oceanography, La Jolla, Calif.

RIVERS are the major contributors of sediment to the bays and Continental Shelf of the northern Gulf Coast. These rivers are building deltas so rapidly into the bays and the open ocean that charts and maps become obsolete almost as soon as they are printed. For many miles beyond these areas of rapid deposition, distinctly deltaic types of sediments are distinguishable, even seaward of the inlets of bays into which a few large rivers empty. The characteristics of sediments which earmark them as indicators of deltaic origin are: abundance in the coarse fraction (greater than $\frac{1}{8}$ mm.) of wood fibers, aggregates (mostly ferruginous), and mica, along with a low percentage of foraminifera and mollusks. In shelf sediments echinoids and glauconite are both much rarer in these delta-derived sediments than elsewhere. Near the mouths most of the sediments have a fine lamination that is distinctive from that of most other marine environments. In many places along the Gulf Coast, as elsewhere, higher content of silt and clay in the sediments derived from the rivers produces the apparent anomaly of coarser sediments on the outer shelf than near shore off the river mouths.

Our studies suggest that the Mississippi Delta and its surroundings are comparable with the situation off other large rivers in having sediment units that can be divided on a physiographic and lithologic basis into topset, foreset, and bottomset beds. The foreset slopes of only about 1 per cent are similar to those off other larger deltas. The unusual "birdfoot" outline of the Mississippi Delta is being rounded out by the growth of subdeltas into a form more like that of other large deltas. Almost the only unique feature of this delta is that two of the major distributaries have built entirely across the Continental Shelf.

Comparative Studies of Sedimentation In Selected Texas Bays

GENE A. RUSNAK and FRANCIS P. SHEPARD, Scripps Institution of Oceanography, La Jolla, Calif.

SEVERAL Texas bays that range from moist subhumid through semiarid climatic belts have been studied for characteristic sedimentary features. All of these bays are separated from the open gulf by wide barrier islands. In the subhumid area the gulf inlets are more closely spaced and there are many entering streams, whereas a large extent of the semiarid region has no breaks in the barrier island and no appreciable entering stream. Furthermore, the barrier dunes of the semiarid region have much less vegetation and thus are more mobile.

These physiographic, hydrographic, and climatic differences produce rather strikingly different types of bay sediments. The barrier dunes, for example, contribute large quantities of wind-blown sand into the adjacent semiarid bays, making these sediments high in sand content. On the other hand, river-derived sediments, high in clay and silt content, dominate in the subhumid bays. High rates of evaporation in the semiarid region produce hypersaline conditions, which result in the precipitation of chemical deposits in the form of calcareous aggregates, calcareous oolites, and gypsum. The oolites appear to be related only to present or earlier shore lines. Laminations in the sediments are common in the semiarid bays because of rapid deposition, but are found in the subhumid bays only in the vicinity of river mouths.

On the other hand, the bays of both climatic zones have some features in common. Extensive oyster reefs and abundance of brackish-water organisms, and the absence of echinoids and some other shelf forms are characteristic of bays in both regions. Areas of mixed bay and shelf fauna and minor amounts of glauconite are common only to the bay inlets.

Sediments of the Continental Shelf of the Northwest Gulf of Mexico

JOSEPH R. CURRAY, Scripps Institution of Oceanography, La Jolla, Calif.

MEGASCOPIC lithology and size distributions have been studied for over 1,000 sediment cores from the Continental Shelf of the northwest Gulf of Mexico, and the composition of the sand fraction, mineralogy, macroorganisms, and foraminifera have been studied in representative samples from these cores. Thicknesses of the postglacial sediments have been estimated by changes in fauna and lithology in long piston cores.

Postglacial sedimentation has been generally uniform in covering Pleistocene sediments west of the Mississippi Delta along the middle and outer shelf off Louisiana, along the outer edge of the shelf off eastern Texas, and in a wide zone across the shelf off Central Texas. Thicknesses of 3 m. and over are common for these areas. Elsewhere, deposition appears to have covered Pleistocene sediments only in the depressions, giving an extremely variable thickness of Recent sediments. Most of the Recent sediments are silty clay, grading rapidly to sand near shore.

The sediments in the areas of variable postglacial deposition are generally sandy. These sediments are believed to have been derived from reworking, under shelf conditions, of old shore-line deposits laid down during Pleistocene lowered sea levels. Some of these deposits were locally cemented to form low banks or mounds of beach rock and coquina. Study of the higher banks on the shelf has shown preferred summit and terrace depths, suggesting erosion during still-stands of sea level at about 9, 30-35, and 45-50 fathoms. Miocene rocks were dredged from one of these banks.

Geology and Geophysics

PAUL L. LYONS, Sinclair Oil & Gas Co., Tulsa.

COORDINATION of geology and geophysics has progressed tremendously as new and powerful exploration techniques have been evolved. It is apparent that the highest degree of resolution for location of oil, gas, and uranium traps has come through the construction of multiple maps, both geological and geophysical, which convey a composite picture of all factors leading to the entrapment of the subject minerals. The use of "operational methods" and "information theory" will in the future be handled by machines to a far greater extent. This will lead to processes of "total mapping" designed to pinpoint the remaining available mineral deposits of the world. Such mapping will add greatly to, and to some extent replace, the ingenuity and know-how of the human brain.

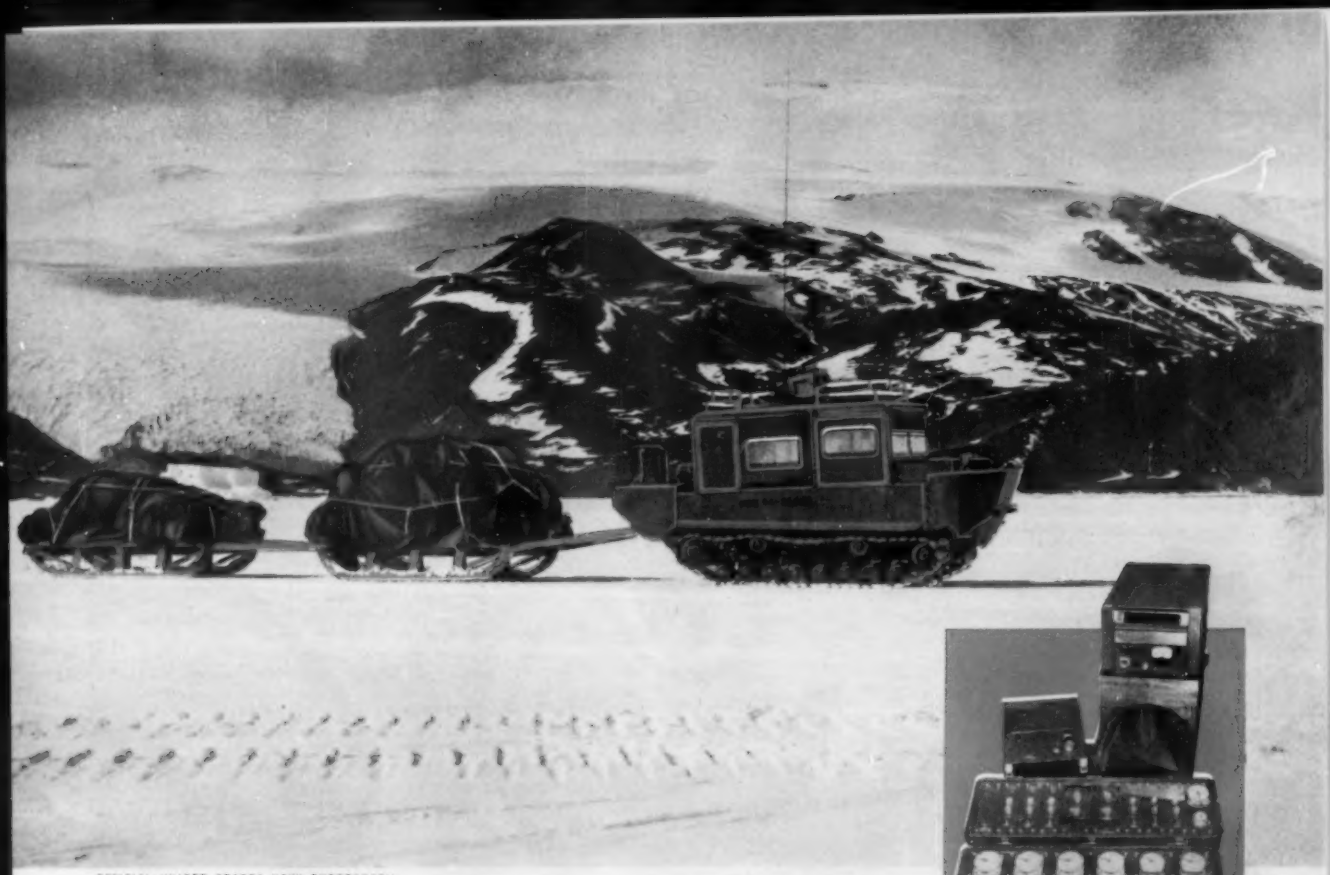
Geophysical Research and Progress in Exploration

MILTON B. DOBBIN, Triad Oil Co., Ltd., Calgary, Alta., Canada, and **HENRY F. DUNLAP,** Atlantic Refining Co., Dallas.

THIS paper, the S.E.G. Research Committee's second annual review of current developments in exploration geophysics, will emphasize research activities at universities and other noncommercial institutions which relate closely to geophysical exploration.

Such activities are of two kinds. First, there are studies of basic physical principles underlying current or prospective exploration methods which could lead to improvements and new applications. Secondly, geophysical methods originally developed for petroleum exploration are being employed for large-scale investigations of the earth's crustal structure. These studies should contribute important information on the geology of such feaures as continental shelves, geosynclines, and mountain systems, information potentially useful to geologists for developing new concepts in exploration thinking. The two kinds of research illustrate the current interdependence between "pure" and "applied" geophysics.

Important research projects on scattering, statistical improvement of signal-to-noise, explosion-wave generation in the earth, and surface waves exemplify the activity going on in university laboratories today which



OFFICIAL UNITED STATES NAVY PHOTOGRAPH

7000B Portable Seismograph showing RS-8U camera, dynamotor, control panel, and one bank of six amplifiers (IGY systems have four banks of six amplifiers, or 24 traces).

7000B Seismographs selected for International Geophysical Year

U. S. ANTARCTIC PROGRAMS

GLACIOLOGISTS of the United States National Committee recommended the "all purpose" seismic systems, developed by Texas Instruments Incorporated, as the best suited to exploit seismograph techniques in glaciological study during the IGY program. For this important program, operational versatility, accurate performance, and rugged dependability were the governing criteria in equipment selection.

The 7000B "all purpose" system offers three seismographs in one—a frequency range of 5-500 cps with a flip of switches. The VLF or Refraction Seismograph included in the 7000B will be used primarily to determine the velocity variations of the seismic waves in the ice sheet. The HR High Resolution Reflection Seismograph will provide accurate data on the stratigraphy and structure of the glacier and near-surface formations, while the Conventional Reflection Seismograph will supply useful deep information from the sub-glacial floor. All three methods will utilize the many filtering variations available in the 7000B to obtain the optimum signal-to-noise ratio of desired impulses.

Since each seismic traverse party will operate as a self-sufficient unit, the low maintenance reputation of the 7000B Seismograph was also an important factor in its selection. And needless to say, these seismic systems will be subjected to extremely exacting operating conditions in the Antarctic—conditions that will ask the most of equipment and men.

Texas Instruments Incorporated is proud that under circumstances where *quality* counts most, the USNC glaciologists selected 7000B Seismographs.

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may result in improved seismic exploration techniques tomorrow. Conversely, university-sponsored seismic and gravity investigations of deep oceans, the continental margins and various western mountain chains illustrate how geophysics is contributing basic geologic information on a regional to global scale.

Within the geophysical industry, principal progress has been in consolidating and perfecting such developments as magnetic recording and velocity logging. A fathometer-type device for continuous mapping of layers several hundred feet below the ocean bottom should facilitate the detailing of very shallow salt domes offshore. There have been significant innovations in logging techniques, particularly in the use of in-hole accelerators for neutron generation, the development of in-hole equipment for measuring gamma-ray spectra, the development of displacement logging, and the development of wire-line equipment for making formation tests.

Developments worth noting in the seismic field include pressure-sensitive geophones with preamplifiers, which are used in the bay and marsh areas of the Gulf Coast, and nonphotographic methods of reproducing seismic data. During the past year considerable experimentation has continued with weight-dropping techniques, and with use of higher frequencies to get better resolution. The use of models, particularly two-dimensional models, is increasing.

Gravity Studies of Basin and Range Geology

DON R. MABEY, U. S. Geological Survey, Salt Lake City.

THE Basin and Range province is characterized by roughly parallel mountain ranges separated by relatively level desert basins. The basin areas generally contain deposits of Cenozoic age which may consist of only a thin cover of Quaternary alluvium or basalt, or thousands of feet of nonmarine sedimentary rocks and volcanic rocks. Because a Quaternary cover obscures the underlying geology in most basin areas, some method of obtaining subsurface information is necessary for an understanding of the geology in the basin areas.

The USGS has found that gravity observations are effective in studying the geology in the basin areas. There is generally a significant density contrast between the Cenozoic rocks and the pre-Cenozoic rocks, so the gravity data can be used to infer the general configuration and extent of the major Cenozoic deposits. Lateral and vertical density variations within the Cenozoic sediments and volcanic rocks can create serious problems in the interpretation of the gravity data, but it is possible to infer considerable structural information from the gravity data. When the gravity data are considered along with the present physiography and areal geology, it is often possible to obtain a good understanding of the Cenozoic geology in a local area, including the nature and sequence of tectonic events and the transport of sediments.

In addition to the information the gravity data reveal about local geology, more extensive regional anomalies have been observed. Where the boundaries of the Basin and Range province are clearly defined there seem to be important gravity variations, as for example along the eastern front of the Sierra Nevada and the Wasatch front. The relationship of the gravity anomalies over basin areas to the anomalies over mountain areas, excluding the effect of basin-fill material, is being investigated but the results are inconclusive.

Gravity studies will not provide all the answers to the complex problems of Basin and Range geology. However, both extensive and intensive gravity surveys are making a considerabule contribution to the understanding of the geology in the province.

Use of Aeromagnetic Data to Determine Regional Basin Topography

W. J. DEMPSEY, U. S. Geological Survey, Washington, D. C.

MOST sediments are nonmagnetic. Therefore relatively large magnetic anomalies observed above sedimentary basins are due to susceptibility changes within the underlying crystalline rocks. If the interface between the crystalline rocks and the sediments is regarded as the upper surface distribution of poles of the anomaly-producing mass, information concerning the topography of the crystalline rocks can be found by analyzing the magnetic data in terms of distance from the plane of observation to the top of the magnetic mass.

Where there is sufficient magnetic detail, second derivative maps calculated from magnetic contour maps are used in making the depth calculations, but other diagnostic features such as the horizontal extent of the steepest gradient and of half-maximum points are also useful.

Some magnetic anomalies from intrusions can be recognized as nonbasement effects. If these effects are not recognized as such, the calculated depth to crystalline basement will be too shallow. Metamorphic rocks of low magnetic susceptibility can not be distinguished from normal sediments except where buried at shallow depth.

Depth calculations are presented from parts of Alaska, Indiana, the Atlantic coastal plain, the Mississippi coastal embayment in Arkansas, and in the central lowlands of Wisconsin.

Continuous-Velocity Logging—Its Application to Oil Finding

T. J. O'DONNELL, A. R. GREGORY, A. J. de WITTE and **M. R. J. WYLLIE**, Gulf Research & Development Co., Pittsburgh.

NEW devices for logging the acoustic velocities of formations penetrated by a bore hole are described. Logs recorded with these devices have been compared with synthetic velocity logs compounded from data measured on cores, and the devices appear to be technically satisfactory although still open to improvement.

If continuous-velocity logs keep growing in popularity, immediate benefits may be expected from their use (1) as correlating tools in areas where other types of logs are not wholly satisfactory; (2) as devices for giving quantitative data concerning lateral variations in velocity, thereby increasing the accuracy of seismic interpretations; and (3) as a source of data for the compilation of artificial seismograms. The latter will, in turn, help to pin point the source of seismic reflections and should permit a better evaluation of the effects on seismic records of bed thicknesses and lithology.

Laboratory studies have produced information on the relationship between acoustic velocity and rock characteristics which should permit the evaluation of the porosity of many rocks from their measured velocities. Although the direct effect of oil and gas on the seismic velocity of rocks appears to have been over estimated, the combination of velocity and electric logs should make it easier to recognize zones of saturation. In some cases the combination of acoustic velocity and neutron-log information should yield evidence concerning the nature of the porosity in carbonate rocks, i.e., the relative amounts of vugular and intercrystalline porosity.

Similarly, studies of the relationship between acoustic velocity and lithology should enable a seismograph map to give information concerning the economic properties of subsurface rocks without recourse being made to the drill.

Continuous-velocity data should also be an aid in the fundamental study of seismic wave propagation and the internal structure of the earth.

The Marine Sonoprobe, a New Type Echo Sounder for Use in Geologic Mapping

C. D. McCLURE, H. F. NELSON, and **W. B. HUCKABAY**, Magnolia Petroleum Co., Dallas

THE Sonoprobe is a low-frequency echo sounder that puts out a dominant frequence of 3,800 cycles per second. Sonoprobe profiles of the recent sediments in the Gulf of Mexico illustrate many geological features, including buried channels, reefs, anticlines, faults, facies changes, and sedimentary pinchouts. Bottom-sediment sampling and coring have shown that there is a good correlation between changes in the type of sediment and reflections. The various factors that affect the quality of the records and the depth of penetration of acoustical energy are:

1. The speed and course of the boat with respect to the direction of waves and currents.
2. The installation of the instrument.
3. The proper selection of the acoustical pulse, dominant frequency, and pulse shape.
4. The energy of the pulse.
5. Depth of water.
6. Geological conditions such as the type of sediment, the thickness and depth of the reflecting horizon, and possibly the moisture content.

The potential value of the Sonoprobe can be more readily realized by accompanying a sounding program with a coring and sediment analysis program.

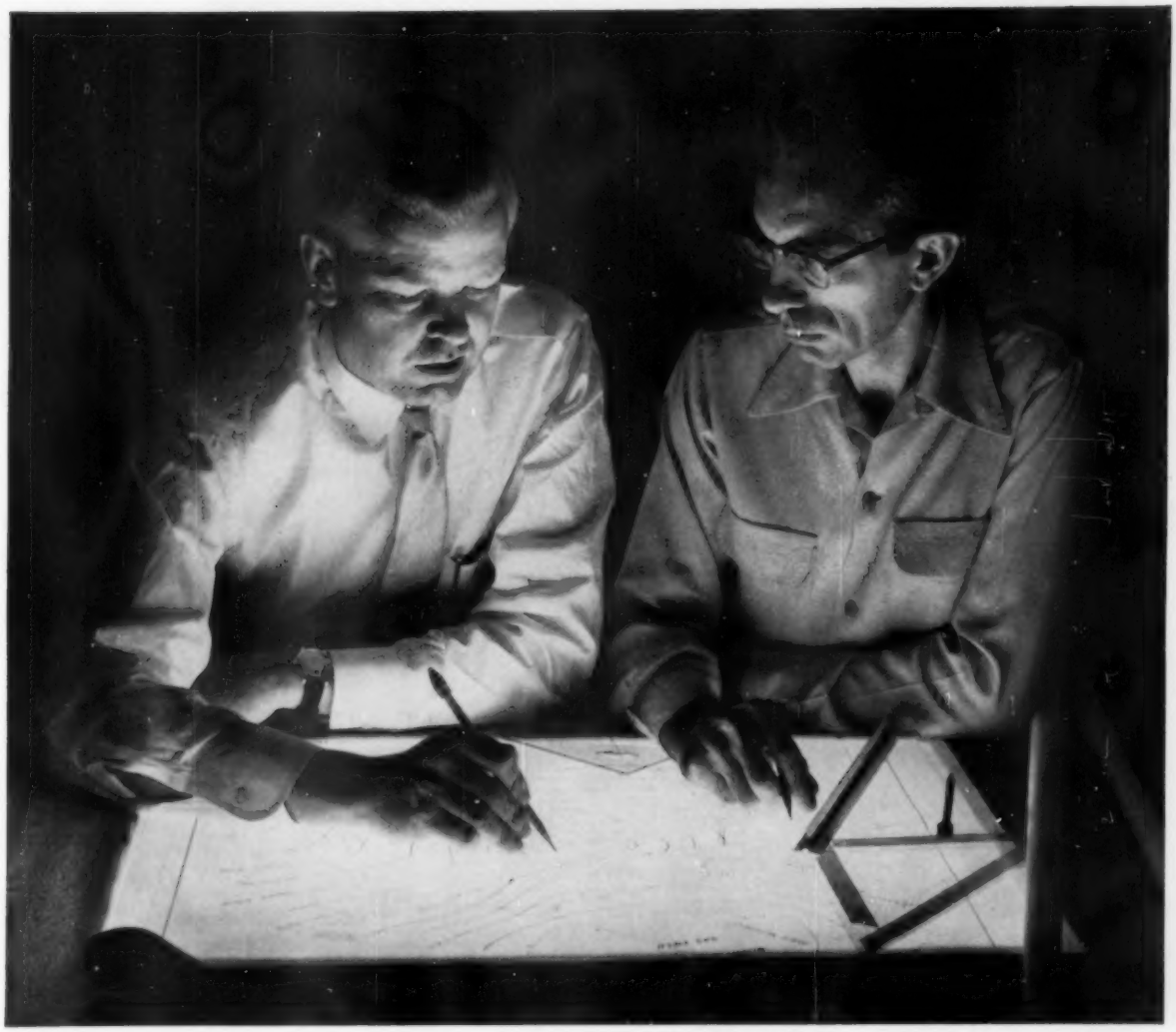
Cost of Educating One Geologist

ERNST CLOOS, Johns Hopkins University, Baltimore.

OBVIOUSLY, the cost of educating a geologist will vary with the educational institution, size of department and classes, quality of raw material, level of education, and methods of cost accounting, and with certain premises. Based on answers to a questionnaire, the cost has been calculated for several universities using the following formula.

$$\frac{\text{Department budget plus 25 per cent overhead}}{\text{½ number of A.B. plus M.A. plus Ph.D. candidates}}$$

The average undergraduate student-year costs $3,000. The average graduate student-year costs between $4,000 and $5,000 (up to $9,000). To this should be added the cost of the dissertation and "on the job" training. The institution, therefore, spends about $12,000 on an A.B. candidate, or a cumulative total of $16,000-$17,000 if study is continued to an M.A., and $24,000-$29,000 if the candidate completes his Ph.D. program. Graduate schools who accept an A.B. from elsewhere spend $4,000 to $8,000



Getting the most from data obtained is a matter of skill and experience. The key personnel in IX interpretation average more than 15 years experience.

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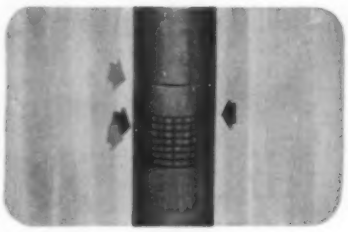
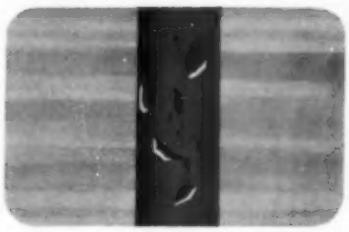
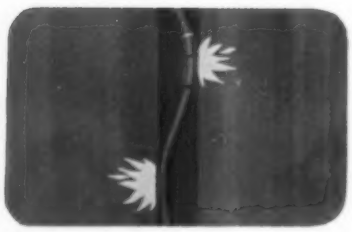


Notch Fatigue (Slip Wear)—Transverse notches, such as those caused by slip teeth can make even relatively new pipe fail. Crosswise notches and scars are natural stress raisers and are an open invitation to failure and fishing jobs.

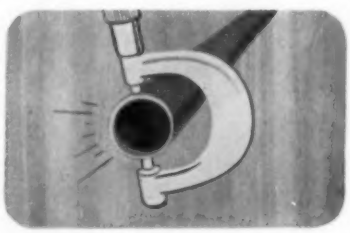


Corrosion Fatigue—Corrosion fatigue is one of the most common causes of drill pipe failure. Pipe becomes pitted. Pits become stress raisers as pipe bends. Cracks develop. Joints deeply pitted are usually unsafe.



Crooked Pipe—Running pipe in compression, dropping pipe while pulling up or laying down joints, or careless handling during transportation can crook pipe. Crooked pipe is more likely to fail from fatigue, and accelerates wear on tool joints.

"Necked Down" Pipe—Using tongs on the body of the pipe or careless setting in the slips when tripping heavy strings can crush the pipe. Pulling too hard on stuck pipe will cause it to neck down.



Worn Pipe—The straightest pipe wears. Crooked pipe wears lopsided. Depth of well to be drilled, corrosion and other factors affect how hard pipe is stressed and, consequently, how thin it can be worn before it is dangerous to run.

Most operators have to retire some drill pipe with each well drilled . . .

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Field Replaceable Tool Joints

Drill pipe failures often occur when there are many thousand feet of good service life left in the tool joints. Why lose both? With Field Replaceable Reed Super Shrink-Grip tool joints, you can retire the pipe, remove the tool joints and apply them to new pipe right in the field with your own labor. There's no costly delay, no transportation or shopping expense, and most important . . . you don't lose your original investment in the tool joints which amounts to approximately 50 percent of the cost of your drill pipe-tool joint string.

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"Carrot-Free" Jet Perforating Developed by McCullough Six Years Ago

Slug-free Glass Jet shaped charges were introduced to the oil industry six years ago. In all these years of use in thousands of wells, and through hundreds of competitive tests conducted or witnessed by oil company engineers, there has never been evidence that carrots or slugs were formed when McCullough Glass Jet Units were fired.

Throughout the years, "carrot-free" jet penetration has been one of McCullough's major advantages. Yet the fact was hard for oil men to believe, because *all other* jet perforating processes did form carrots. Their presence was accepted as an unwanted but natural consequence of the process.

THEN CAME FINAL PROOF—proof so final that many of the other perforating companies were forced to the need of improving their processes. In a recent major penetration research project, McCullough Tool Company was the only service company that consistently shot clean, "carrot-free" jet holes. Others participating consistently produced slugs or carrots that partially or completely plugged the perforations.

You'll hear a lot of sales talk—see a lot of claims about new "carrot-free" jet perforating methods as a result of these tests—but remember, McCullough Glass Jet Units are the *only* shaped charges that have been actually *proved* "junk-free" through six years of satisfactory service.

In addition to being "carrot-free" McCullough Glass Jet Perforators are almost 100% junk free from other sources. The Glass Jet Units completely disintegrate when fired—no metal, rubber or synthetic fragments to plug perforations or leave junk in the hole. Also, after firing the Steel Strip Carrier is removed from the hole intact.

Glass Jets Perforate 7 Zones in 200′ of Formation in 2 Runs

Powerful, Junk-Free Glass Jets in Steel Strip Carriers Shoot 7 Zones for 970 B/D—Lost Production Regained by Use of McCullough Combination Services.

Drilled in 1946, this well was completed by setting 7″ O.D. casing on top of the pay zone, drilling into the pay with a 6½″ bit and producing from open hole. Recently gas broke into the hole from an adjacent gas injection well and almost entirely killed production.

Operator decided to cement a 5″ O.D. liner in open hole below the 7″ casing, but, while attempting this, they discovered they had a bad place in the 7″ at 2500′. A 5¾″ O.D. McCullough Bridge Plug was set below the bad spot and the hole was squeezed off. The Bridge Plug was drilled out and a combination string of 5½″ casing with 5″ on the bottom was run out into the open hole below the original casing.

A McCullough Radiation Well Log was run, obtaining Gamma Ray and Neutron Curves and a simultaneous collar log. The log revealed seven productive zones spread over 200′ of formation—a total of 150′ of pay zones to be perforated.

Two 100′ Steel Strip Carriers were loaded with Standard Casing Glass Jets, leaving blank sections to straddle unwanted zones, and the 7 pay zones were shot with a total of 600 shots.

The well came in making over 1100 barrels and has settled to a steady production of 970 barrels of oil per day—slightly more than it had originally produced from the open hole completion. The operator was well pleased with the fine results obtained with McCullough Services and, because of bonus production, is programming several wells to be re-worked in the same fashion.

Here is the ONLY jet perforating charge that has been PROVED "carrot-free" and "junk-free" by six years of actual field use—the McCullough Glass Jet Unit.

The versatility of Glass Jet Perforators with Steel Strip Carriers is well-known—the oil industry has been using them successfully for the past six years. The advantage of being able to run extra long Steel Strip Carriers, to straddle unwanted intervals and perforate any number of pay zones in a single run has been proved by hundreds of jobs like the above. Add to this the fact that McCullough is the *only* service company able to offer *proved* carrot-free, junk-free perforating and you've got a perforating value that can't be topped—always specify McCullough Glass Jet Perforators.

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for an M.A., and between $12,000 and $15,000 for the Ph.D. if the student completes his work in 3 years or $16,000 to $20,000 if he needs four.

Somehow this staggering bill is being paid, but only to a small extent by the student. A full-time student cannot pay his way. He must forego working for an income, and usually does the best he can to meet expenses. All too frequently he exists on a shoestring.

The actual cost to an institution is reduced by the amount of tuition paid by the student or by fellowship donations, project grants, and similar financial aid. Graduate students seldom pay tuition and except for some financing of these, little "outside" help is available.

A highly trained, well-qualified owner of a degree is the product of an expensive and complicated refining process. The products of public institutions are in some measure paid for by the recipients of the degrees, the employers, and by taxes collected. The private institutions, on the other hand, are dependent largely on gifts from industry and alumni. If society needs and demands geologists it must be prepared to foot the bill, and industry, the immediate beneficiary, must pay its share.

Application of Photogrammetry to Isopach Mapping Structure Contouring, and Other, Similar Geologic Problems

WILLIAM R. HEMPHILL, U. S. Geological Survey, Washington, D. C.

PHOTOGRAMMETRIC methods are being used by the USGS to obtain geologic measurements from aerial photographs; some of these measurements include determination of stratigraphic thickness and strike and dip. In Arizona, Utah, and northern Alaska isopach and structure-contour maps have been completed entirely from aerial photographs by photogrammetric methods.

Instruments used to obtain geologic measurements from aerial photographs are illustrated and their operating principles described briefly. To demonstrate some of the applications of these instruments to geologic study, several isopach and structure-contour maps are discussed. Reference is made to photogrammetric instruments and methods used in determining strike and dip from aerial photographs.

Some Offshore Exploratory Problems

IRA H. CRAM, Continental Oil Co., Houston.

THE area off the coasts of Louisiana and Texas out to the edge of the Continental Shelf (water depth 600 ft.) is a little larger than the onshore Gulf Coast producing province. Together the onshore and offshore constitute one geological entity. It is not surprising that exploration of the offshore, using 50 odd years of onshore experience, has resulted in an outstanding discovery record. This record does not suggest that the offshore will eventually produce more hydrocarbons than the onshore. Neither does it suggest that geologists and geophysicists can relax and assume that they have fewer problems than usual. On the contrary, no group of geologists and geophysicists ever needed sharper tools and sharper wits if they are to contribute satisfactorily to the problem of making the offshore an economic venture. Thus the offshore is a challenge to geologists and geophysicists to improve materially their tools and their thinking at the earliest possible date.

Training the Explorationist

J. M. MARSH, Imperial Oil Ltd., Edmonton, Alta.

THE need for well-rounded explorationists in exploration departments is urgent. Costly errors in judgment have been made by geologists and geophysicists who do not understand each other's work and needless dry holes have been drilled.

Imperial Oil, Ltd., has organized a program designed to train geologists and geophysicists as well-rounded explorationists. Training starts with summer courses for university students. A 1-year training program has been set up for permanent new employes, during which time only geological and geophysical tasks are assigned under experienced people. Thereafter special training in quantitative log interpretation, photogeologic interpretation, and other subjects is given to qualified employes. Some very successful results have been attained in the advanced training courses.

Geologists and geophysicists should benefit from an intensified interest in and understanding of all phases of exploration and should, as a result, make fewer errors in judgment due to overspecialization in some subject and ignorance in others. Higher staff morale should follow the preparation of men for faster promotions and a resulting decrease in rate of terminations.

Fracture Analysis Studies

P. H. BLANCHET, Blanchet & Associates, Ltd., Calgary, Alta.

IN a fracture-analysis survey, rectilinear features that are considered to be the surface expression of deep-seated fractures, joints, or fracture zones must be recognized on aerial photographs. These features are then measured and analyzed.

As part of active exploration programs for oil companies, 60 areas, totaling 25,000 sq. miles, in many widely scattered parts of the Great Plains region of Canada and the United States, have been analyzed in detail. Additionally, many other areas have been examined. The following summary statements are made on the basis of this work.

1. In accordance with the present working hypothesis, many of these lineations or "fractures" were initiated at or near basement level. This initiation may be the result of crustal tides and, probably, other lower-frequency movements. Such fracture zones, extending to the surface, are considered to have been propagated and multiplied upwards through the sediments by this same action, even through topsoil and thick glacial overburden. The hypothesis for this process requires areas in which there is: (a) a lateral homogeneity of the sedimentary rocks; (b) a reasonable absence of major orogenic disturbances; and (c) a surface essentially plain in character.

2. Four principal fracture directions or sets are present in all areas examined. They are probably present in most if not all sedimentary areas.

3. From one area to another, the orientation of the mean direction of each fracture set is regionally systematic, not haphazard. This is plausibly explainable by the hypothesis.

4. Underlying, and even deep-seated, structure or stratigraphic anomalies may be indicated quantitatively by: (a) local deviations in the statistical mean direction of one or more fracture sets; and/or (b) in the fracture incidence (number of unit fractures per unit area). Such deviations are being analyzed mathematically to estimate the location, size, and form of the anomalies.

Time of Deformation in Structural Evaluation, Grenville Dome, Wyoming

JAMES A. BARLOW, JR., Forest Oil Corp., Casper, Wyo.

TIME of deformation and post deformational history are important and often overlooked or underestimated factors in evaluation of a structural prospect. These factors are more important in some areas than in others.

In oil provinces dominated by structural hydrocarbon accumulation, the merit of dry structures is often seemingly equal to that of the producing structures. In the Rocky Mountains, there are many anticlines that have yielded no oil even though they contain the same rock sequence and the same stratigraphic potential as the producing folds.

An example is Grenville dome, located in central Wyoming. This is a "textbook" anticline that has been tested by 10 wells. No oil or gas has been found. Structural studies of the dome and the nearby Rawlins uplift have shown that the closure on the fold was established in late Tertiary time and that prior to that time the dome was an open nose.

Grenville is an east-west trending fold formed during Laramide folding, with Upper Cretaceous rocks at the surface and 2,000 ft. of Mesozoic and Paleozoic rocks in the subsurface. As shown by a geologic map, the rocks on the surface in the area just west of the dome are late Tertiary (Miocene and Pliocene). These rocks have been folded into an east-west trending syncline, which is superimposed on the west part of the east-west trending axis of Grenville dome. When the Tertiary syncline datum is restored to horizontal, the anticline is restored to its pre-late Tertiary position, i.e., an east-plunging nose with no west closure. A structure map showing the dome prior to Tertiary time (an east-plunging fold) makes it evident that late Tertiary history is critical in an evaluation of Grenville dome.

In the Rocky Mountain region, where most of the oil is produced from structures formed during the early part of the Laramide deformation (late Cretaceous and early Tertiary time), a structure with late Tertiary closure such as Grenville is a poor prospect.

It is usually not possible to determine the complete history of an individual structure, but in many places regional history can be applied to specific prospects. More complete use of structural history should increase the over-all success ratio of wildcat wells.

The Pembina Field, Alberta

A. M. PATTERSON and **A. A. ARNESON,** Merrill Petroleums, Ltd., Calgary, Alta.

PEMBINA field is an excellent example of a stratigraphic trap. The oil occurs at the updip (eastern) termination of the Upper Cretaceous Cardium sand. The probable area of the field appears to be somewhat in excess of 800 sq. miles. Production is obtained from at least four separate sands and a conglomerate of the Cardium formation. In some areas all of these reservoirs are developed one above the other and are separated by shale breaks. As the areal distribution of the various reservoirs

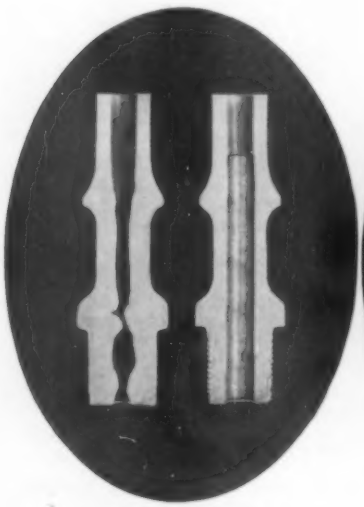
AXELSON

OPERATORS CONTROL CORROSION AND PARAFFIN WITH HOL-O-RODS

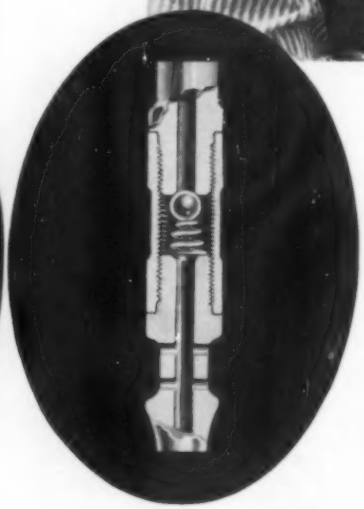
Close control of corrosion and paraffin conditions 'way down below is being practiced by the two operators on this page, with the help of Axelson HOL-O-RODS.

At left, Carter Oil Company Production Foreman Bill Dancy is supervising the running in of 1" HOL-O-RODS at J. Detrich #8, Trapp Pool, Kansas. Damage to equipment caused by troublesome conditions is substantially reduced by injecting corrosion inhibitor 2100 feet down through these hollow sucker rods into the reservoir. The same HOL-O-ROD installation is being used at the nearby J. Detrich #5.

PARAFFIN CUTTING. Injection of a paraffin solvent through Axelson HOL-O-RODS is being discussed by (l. to r.) Jim McKenzie, Axelson representative; Ernie Brant, Axelson District Manager; and Marlin Archer, pumper for Carl I. Olsen, producer. Located at Lake Houston, Texas, this well (State Lease Taylor #1) is using an Axelson plunger pump set at 5000 feet, and a complete string of Axelson HOL-O-RODS.



FIRST ONE-PIECE NON-WELDED hollow sucker rod in the field is the Axelson HOL-O-ROD, pictured above in two stages of manufacture. To avoid breakage resulting from the common practice of fabricating rod ends separately and then welding the ends to the rods, Axelson works the rods all in one piece, upsetting the ends, as shown in the left cross-section, and then re-drilling the hollow portion.



CHECK VALVE to prevent the back flow of well crude through HOL-O-RODS can easily be installed at the lower end of a rod string by using a standard coupling with a spring-loaded ball and seat, as shown in above cutaway drawing. Beyond this check, the injected fluid is ported to the annulus through drilled holes in a HOL-O-ROD Pony Rod. Axelson representatives can supply details.

AXELSON HOL-O-RODS were developed for use in hot oil treatment of oil wells to control paraffin, for chemical injection in corrosion control, for diluent injection to aid in the production of extremely viscous crudes, and for treating two-zone pumping wells.

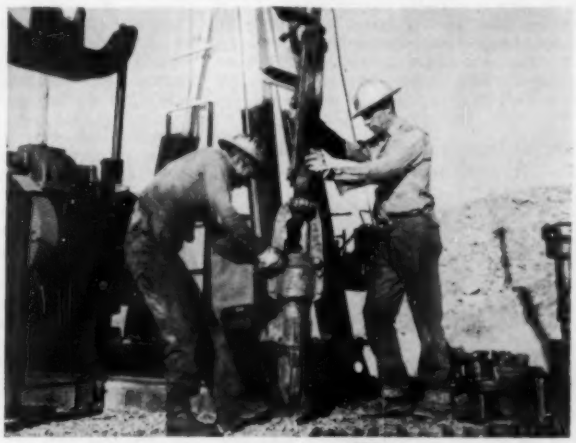
These applications have created another use for HOL-O-RODS: a means of determining bottomhole pressures by application of pressure bombs directly at the surface of the well. Still other uses are constantly being found by men in direct contact with producing problems.

PICTORIAL

QUICK FRAC. Shown supervising their first "River Frac" in Osage County, Oklahoma, are two district production superintendents for National Associated Petroleum Company—Bud Shewmaker (standing) and Pete Clark Jr. (kneeling with cap). It took only 38 minutes to frac the formation at 2500 feet with 1562 bbls. of sand, water, and mud acid. An Axelson 2 x 1½ x 10′ 2″ Sure-Seal Pump with double Axloy valves and a 44″ chrome-plated grooved plunger produces this well (Rodeo Anticline #5-6). These pumps are standard equipment for most wells in the Osage. The sucker rods at lower left are Axelson #60 ⅝″.

OLD FRIENDS. On board the "Gulf Pride" at Caddo Lake, Louisiana, are two longtime friends: Cleon Worley, Axelson District Manager and Axelson employee of 32 years, and M. V. Daniels, Assistant Area Superintendent for Gulf Refining Company. Daniels has served Gulf for more than 27 years in this territory. In this time he has used virtually every kind of pump Axelson has ever made. His wells range in depth from 900 to 6300 feet, and hole conditions vary from "problem children to little angels."

"DO-IT-YOURSELF." The Texas Company's #11 at Black Mountain, Wyoming, was losing production. The Axelson Sure-Seal 2″ bore Rod Pump (API, RWT type) was pulled and checked out O.K. The crew wanted to pull the tubing wet to check it for leaks, but didn't have a drop valve. They made one out of the Axelson cup hold-down, and it did the job. Pictured pulling the well are two members of Dick's Well Service out of Powell, Wyoming (l. to r.): Clark Rook and Joe Mosebar.



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do not coincide, the "lean and rich" areas in the field can be determined by maps outlining the distribution of various sand bodies.

Pembina, situated on a hinge line, is in an area of multiple stratigraphic traps. Besides the Cardium, oil and gas have been obtained from the basal Belly River sands, the Viking sand, and the Mississippian carbonates. All these occurrences are within the limits of Pembina field and all are stratigraphic traps. The reservoirs in these horizons have not been evaluated to any extent at present. These reservoirs will probably not equal those of the Cardium but they will be of very considerable size.

Significant Exploratory Achievements of 1956

FRANK J. GARDNER, The Oil and Gas Journal, Tulsa.

EXPLORATION for oil and gas in 1956 was marked by some unusual geological achievements. Significant advances in discovery thinking were evidenced by important commercial discoveries in new types of traps and in previously nonproductive regions. Several large uplifts and basins that had challenged the oil finder for years finally fell before the onslaught of drilling, and yielded production for the first time.

The most significant of these 1956 achievements were the discoveries on the Las Animas arch, in the Paradox basin, and on the piercement salt domes of Northeast Texas.

Today's exploratory efforts are oriented in at least four major directions, as oil and gas are found in ever deeper rocks, in hard-to-find stratigraphic traps, in new types of traps on long-known structures, and in areas of earlier failure through the use of new methods of drilling and completion.

Recent Developments in Age Dating By Means of Isotopes

J. TUZO WILSON, University of Toronto, Toronto, Ont.

RADIOACTIVE age determinations and isotopic analyses have helped at least four groups of geologists. Oil geologists have been able to identify some related oil pools by similarities in isotope ratios of the sulfur in the hydrocarbons. In a few cases sedimentary strata, especially glauconite sands and uraniferous black shales, have been dated by these methods. They are not yet precise, however, nor are they generally applicable. Glacial geologists are most fortunate, because carbon-bearing sediments less than 50,000 years old can be dated. Mining geologists dealing with very old rocks are also fortunate because some pegmatites, and many lead ore minerals, can be dated directly.

Age determinations have been of the most value to pre-Cambrian geologists, who know that rocks 3 billion years old (or six times the age of the Cambrian) crop out in shields. They have begun to subdivide the basement into provinces, each formed at a different time. Where exposed on shields, many of these provinces are separated by great faults which are still visible as scraps or which in particular cases have been active since Paleozoic time. A start has been made on dating the covered pre-Cambrian basement by rock samples taken from the bottoms of oil wells.

In the immediate future, it appears that oil geologists will benefit most by the use of age determinations if they remove distortion from the geological time scale and serve correctly to subdivide the basement into its structural elements. A knowledge of the latter would help to explain and possibly predict the location and properties of oil basins.

Isotopic Age Studies at Key Points in the Geologic Column

L. R. STIEFF, T. W. STERN, H. W. JAFFE, and **C. M. CIALELLA,** U. S. Geological Survey, Washington, D. C.

PRELIMINARY istotopic age studies are being made on the radioactive accessory minerals from seven selected igneous rocks in North America. These rocks have been chosen from five areas where detailed field work has been done and where the stratigraphic relations set rather narrow limits for the time of emplacement of the intrusives. The isotopic ages obtained from this preliminary study, combined with the more detailed studies to be made, will be used (1) to establish within the geologic time scale points whose relations to the stratigraphic column are clear, and (2) to compare and evaluate the different isotopic methods of age determination.

The limited data now available suggest that for the same rock the isotopic ages calculated by the different methods, even under the most favorable circumstances, will show some disagreement. In the event of such disagreement, it is hoped that the geologic data on these areas can contribute significantly to the evaluation of the methods, and the identification of the processes producing the age discrepancies, and the selection of the most probable ages.

Total lead-alpha ages have been completed on the radioactive accessory minerals from the intrusive rocks of each area. The method gives calculated ages of approximately 50 million years for zircon in a rock of Eocene age from the Bearpaw Mountains, Montana; 100 million years for zircon in rocks of Cretaceous age from Baja California, Mexico; an average of 230 million years for zircon from rocks of the White Mountain plutonic-volcanic series (Carboniferous) in New Hampshire; an average of 310 million years for zircon and monazite in a rock of the New Hampshire plutonic series (Devonian); and 570 million years for zircon in a rock of the Keweenawan series from Wisconsin.

Identification of Oil Source Beds By Chemical Means.

G. T. PHILIPPI, Shell Development Co., Houston.

SINCE 1943 the Royal Dutch-Shell group have systematically investigated the hydrocarbon content and residual organic content of many types of sediments present in oil basins. Quite generally it was found that small amounts of hydrocarbons, generally ranging from 5 to 5,000 p.p.m. by weight (0.12 to 120 bbl. per acre-foot), are present in dense sediments such as shales, silty shales, marls, and argillaceous limestones. Presently this conclusion is based on the study of oil basins from all over the world and of sediments ranging in age from Recent to Ordovician.

The method for oil source rock identification presented in this paper is based on a technique for differentiating between indigenous and migrated oil. Sediments with indigenous oil are considered oil-source beds. In basins sufficiently far developed to permit such a study, it was found that the portion of the indigenous hydrocarbons left in hydorcarbon-generating sediments is several to many times greater than the oil originally present in all known oil fields combined. Hence in the cases which permitted study, only a small part of the oil generated by the source beds was released to reservoirs. Quite likely, the mechanism of release of hydrocarbons is inefficient in a great many cases. It follows that in many instances the amount of hydrocarbons now present in source beds is of the same order of magnitude as the total amount that was generated. In such cases the amount of hydrocarbon now present can be used to estimate source-rock quality.

Source-rock quality is defined as the amount of hydrocarbons generated per unit weight of dry rock. In order to determine source-rock quality the full range of naturally occurring indigenous hydrocarbon content values has been divided into six subranges according to a logarithmic scale. On a purely empirical basis, to each of these subranges one of the following qualifications was assigned; excellent, very good, fair, poor (marginal commercial), and very poor (noncommercial). A simple graphical method is described for determining the quality of oil source beds from the analytical data obtained in the identification procedure.

Information on source beds can lead to knowledge about the migration pattern of petroleum. A three-dimensional general picture of the migration of oil in many instances will be valuable in petroleum exploration, because it will assist in locating new fields and trends of fields.

Application of Stratigraphic Analysis Methods to the Trinity Group

JAMES M. FORGOTSON, JR., Pan American Petroleum Corp., Tulsa.

ISOPACH and lithofacies maps of the Trinity group and selected units therein are used to illustrate methods of presenting, in map form information obtained from electrical logs, sample logs, etc. The maps serve as a basis for interpreting the tectonic framework and regional environmental setting existing during deposition of the unit.

The sediments of the Trinity group were deposited in an intracratonic basin flanked by shelf areas on three sides and the Gulf of Mexico on the south. The Trinity group thins depositionally toward the margin of the basin and becomes part of the undifferentiated Lower Cretaceous clastic section overlapping onto the shelf. During late Trinity deposition gulfward tilting of the shelf and renewed uplift along the basin margin produced a withdrawal of the sea accompanied by advance of the deltaic front from the major source area (southern Appalachians). Embayments (areas of greater subsidence) extending into northwest Louisiana and central East Texas were separated by a platform (area of less subsidence).

Certain trends of oil and gas production and favorable areas for exploration can be empirically related to the facies pattern without reference to the tectonic or environmental interpretation.

Insoluble Organic Matter (Kerogen) in Sedimentary Rocks of Marine Origin

J. P. FORSMAN and J. M. HUNT, Carter Oil Co., Tulsa.

KEROGEN was isolated, by techniques developed in this study, from 21 rock samples representing a wide variety of ages, lithologies, and environments of deposition. The new techniques make it possible to sep-

arate relatively mineral-free kerogen from rocks containing less than 1 per cent of organic matter. With the recovery of relatively pure kerogen, it becomes possible to make reliable measurements of physical and chemical properties which otherwise would be difficult or impossible to obtain.

Rocks deposited under marine conditions appear to contain either of two types of kerogen. One type is remarkably similar to coal in many of its properties, whereas the other is more like the kerogen of oil shales.

Although age and lithology show little correlation with kerogen properties, there is evidence that the elemental composition of kerogen is controlled to some extent by the environment under which the rocks were deposited. Metamorphic forces also have affected the properties of kerogen, just as they have in coal. Two metamorphosed rocks yielded anthracite-like kerogen and in one of these the presence of graphite was firmly established.

Evidence is also presented that nitrogen occurs in both the organic and inorganic phases of sedimentary rocks. Metamorphic forces do not appear to have changed the nitrogen content of kerogen relative to carbon, except during the late stages of metamorphism.

Although most oil probably originated from hydrocarbons in living organisms, some of the observations made in this study offer support for the theory that some oil may have been derived from kerogen.

Quantitative Stratigraphic Analysis

W. C. KRUMBEIN, Northwestern University, Evanston, Ill.

IN recent years facies and stratigraphic studies are being based more and more on numerical data. Various types of numbers are used to construct contour maps which express stratigraphic relationships in a quantitative manner. These maps, however, are still interpreted subjectively or qualitatively and the selection of trends and patterns that may have economic significance still depends to a large extent on individual judgment and past experience.

Whether presented as maps or not, the numerical stratigraphic data can be evaluated and interpreted by formal analytical and statistical methods. The control wells can be thought of as samples drawn from a three-dimensional body of rock. They can be used to estimate mean values and degrees of variability within the rock body. Moreover, formal mathematical methods may disclose unexpected, but significant gradients and trends. Map values can then be interpolated and extrapolated quantitatively. The best prospects can be chosen by establishing confidence intervals at selected probability levels.

Some of the standard statistical models that may be used in these analyses include row-column and regression designs for studying map gradients, nested sampling designs for estimating relative variabilities, and others that apply in studies of mean values. Examples of facies maps illustrate several situations in which the levels of predictability vary widely because of differences in the "noise level" of the maps.

Design and Interpretation in Facies Studies

L. L. SLOSS, Northwestern University, Evanston, Ill.

FOR a regional facies investigation to be successful, there are several elements of design and interpretation which should be taken into account, and these may determine the success or failure of individual maps. Good **design** requires:

(1) **Purpose.**—No investigation undertaken without a clear-cut purpose in mind can be expected to yield significant results.

(2) **Scale.**—Each study demands choice of **geographic** and **stratigraphic scale.** Whether a continent, a basin, or an extension of a producing trend is involved, early decisions must be reached concerning the dimensions and bounding surfaces of the stratigraphic units to be treated.

(3) **Method.**—The purpose and scale, plus the quantity and nature of the available data, make it possible to select various approaches. These include choice of end members, contour intervals, etc., and may be drawn from experience or invented for the immediate occasion.

Interpretation of the maps produced may be **analytical,** using concepts of environment, mode of transportation, tectonic behavior, etc., or **empirical.** In the latter case the formation studied is compared with other oil-producing formations without necessarily identifying the environment, etc. Empirical treatment can be improved by the application of several new statistical procedures now emerging. These may be used to refine subjective interpretations.

Drainage Patterns—An Aid to Petroleum Exploration in Alluvial Regions

ROBERT L. KITE, Humble Oil & Refining Co., Houston.

MOST major petroleum provinces include extensive areas where the bedrock is masked by alluvium. In these areas drainage-pattern analyses utilizing air photos can be very useful as a reconnaissance method for finding buried structural features. Most of the streams making up the drainage patterns of the alluvial surfaces originated while aggradational processes were active. At this time streams are particularly sensitive to structural movements, and their form and alignments may reflect even minor fracturing and warping.

The first step in drainage-pattern analysis involves efforts to establish the origin and development of an alluvial surface. Principles of stream behavior in a comparable modern environment of deposition then are applied, so that structurally controlled anomalies can be recognized. Although a variety of drainage anomalies are distinguished, they can be grouped into eight basic patterns.

Anomalous patterns associated with known structures are presented from the modern marine strandplains, floodplains, and deltaic plains of the Gulf Coast, as well as their uplifted counterparts on the coastwise Pleistocene terraces. Local disarrangements of drainage over structures on the eolian plain of southwest Texas and the alluvial apron of the High Plains are discussed. At least one of the basic drainage patterns may be used as a guide for contouring subsurface structures.

Advantages and Limitations of Recent Techniques in Photographic Mapping

W. A. FISCHER, U. S. Geological Survey, Washington.

NEW methods have been introduced into each of the three phases of photogeology—interpretation, measurement, and compilation. In general, these new methods hold much promise with respect to increas-

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ing the amount of geologic data and the reliability of geologic data that can be interpreted from aerial photographs.

Stereoplotting and other photogrammetric instruments make it possible to compile geologic maps with increased speed and accuracy. These instruments include the Kelsh plotter, ER-55, Multiplex, and the Orthophotoscope. One of the more promising advantages in interpretation is the introduction of systems using photographs of two or more scales, particularly those using high-altitude photography (scale 1:60,000 or smaller) in conjunction with low-altitude photography. Using small-scale photographs, the oil geologist can often rapidly derive important information about structural and stratigraphic relationships.

Photogrammetric procedures that facilitate rapid and accurate measurement have recently been introduced to photogeologic mapping. These procedures increase the use of measurement in the process of geologic interpretation and facilitate the production of isopach, structure-contour, and similar types of maps. The speed and accuracy with which measurements can be made from aerial photography make possible better understanding of certain geologic features and processes. Color and other types of special photography give much promise for use in the solution of specific geologic mapping problems.

Migration of Oil in Recent Sediments at Pedernales, Venezuela

A. L. KIDWELL and J. M. HUNT, Carter Oil Co., Tulsa.

EVIDENCE for the generation and migration of oil in sediments less than 10,000 years old was found on the flanks of the Pedernales anticline in the delta of the Orinoco River in Venezuela.

The gray clay beds contain an average of about 55 p.p.m. hydrocarbons; in interbedded argillaceous sheet sands that are open to the surface on the flanks of the anticline contain about 40 p.p.m. One lenticular sand about 110 ft. deep, however, contained free gas and was enriched in hydrocarbons, mostly aromatic, to 160 p.p.m. According to carbon 14 age determinations, this sand was deposited about 5,000 years ago.

Ambrosia Lake Uranium Deposit

JOHN A. MASTERS, RICHARD T. ZITTING, FRED A. GROTH, and M. DEAN WEBB, Kerr-McGee Oil Industries, Inc., Denver.

THE Ambrosia Lake uranium deposit on the southern margin of the San Juan basin, McKinley County, New Mexico, contains approximately 60 per cent of the presently proven and probable ore reserve of the United States. The uranium occurs in asphaltic sandstone of the Jurassic Morrison formation. Deposits of the same type and age in the nearby Jackpile and Poison canyon areas comprise a substantial part of the balance of the U.S. reserve.

The major accumulations of asphalt in the Ambrosia Lake area are trapped structurally on the margins of a syncline along the south flank of the Ambrosia anticline or stratigraphically in lenticular sand trends away from the structure. The asphaltic sand is mineralized with uranium. The quantity of ore is approximately proportional to the quantity of asphalt, and no significant quantities of ore have been found which are not associated with asphalt. Over extensive areas, the sandstones surrounding the ore bodies are gray rather than the normal red. Color, structural location, and linear trends are the most reliable guides for exploration.

The sequence of events leading to the deposition of the ore is postulated to be as follows:

1. The Morrison sediments were eroded from granitic and sedimentary rocks a considerable distance southwest of Ambrosia Lake.

2. Uranium, derived from the source rocks, traveled in solution in the stream water and was deposited with the Morrison sands and overlying green shales.

3. A thick Cretaceous section buried the Morrison.

4. Laramide orogeny at the end of Cretaceous folded the Ambrosia anticline.

5. Liquid petroleum derived from the Morrison green shales accumulated in the Morrison sands at the top of the Ambrosia anticline.

6. Tertiary erosion of the rim of the San Juan basin lowered the water outlet and caused the Morrison water table to drop to approximately its present position 250 ft. below the top of the Ambrosia anticline. The petroleum slipped down the flanks of the structure and spilled into the syncline.

7. Loss of volatiles from the oil due to decreased pressure, and oxidation of the oil by moving ground waters left an asphaltic residue.

8. Slightly uraniferous Morrison ground waters moved in large volume through the permeable sands. The reducing environment generated by the asphalt caused precipitation and concentration of the uranium.

The great size of the Ambrosia Lake deposit is largely due to: (1) the abnormal volume of precipitating agent; and (2) the abnormal thickness, permeability, and lateral continuity of the Morrison sands.

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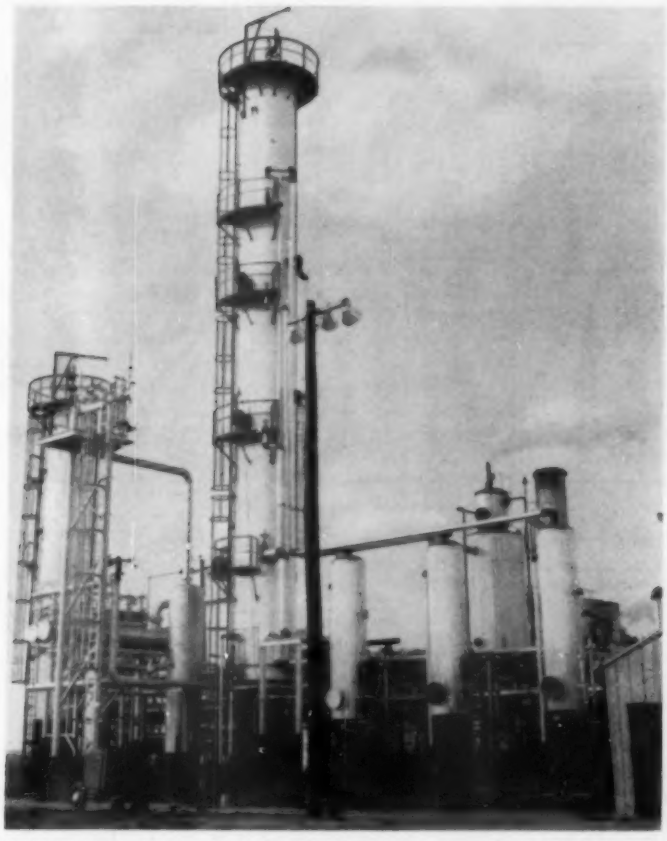


NEW PLANT of Texas Asphalt & Refining Co. is processing 5,000 bbl. daily at its location on the Houston Ship Channel.

is primarily penetration-grade asphalt plus five lighter products; a light front distillate, a heavy naphtha, and three side cuts.

Near General American . . . The plant is located on property adjacent to General American Tank Co.'s tank farm. Texas Asphalt leases the plant site from General American as well as storage for crude and products. The processing company owns the necessary rundown storage to handle all of the varied products.

This arrangement partially accounted for the location of the plant on a compact site. The over-all processing site is an area 246 by 195 ft. This includes space for another plant of equal size, plus an area for a future oxidizing unit, and areas set aside for a welding shop, cooling tower, water-storage tank, electrical substation, and change house.

The Boscan crude is purchased from Richmond Exploration Co. in Western Venezuela, and shipped to Houston in T-2 tankers. The crude has a gravity of about 10° A.P.I., and the 16-in. unloading line at the General American terminal is steam jetted to handle this material.

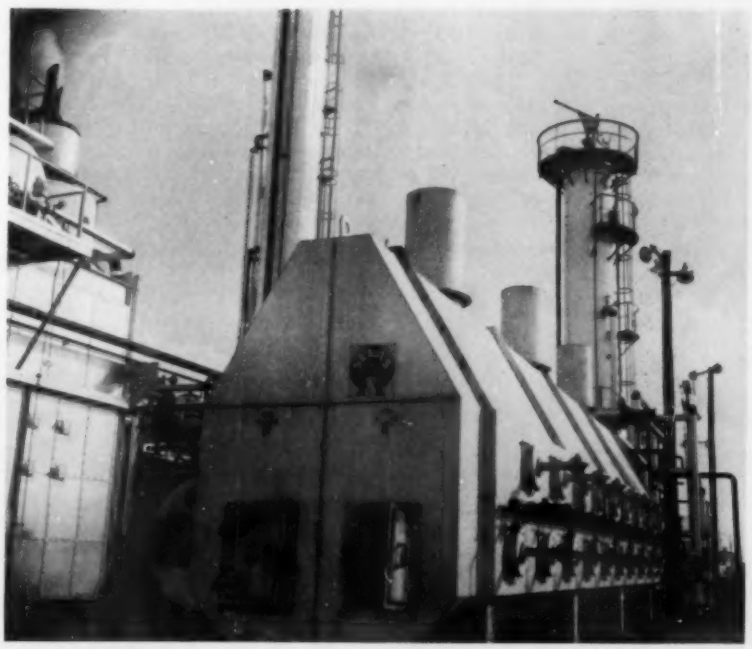
As with many Latin American produced oils, the crude has a much lower flash point than domestic asphalt crudes—112° F. by the Pensky-

New Asphalt Plant Charges Boscan Crude

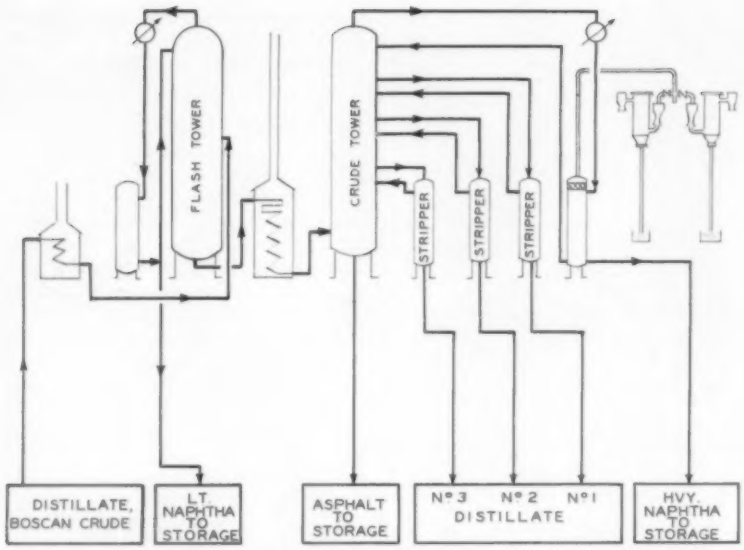
by Larry Resen
District Editor

A NEW asphalt refinery has been placed on stream by Texas Asphalt & Refining Co. on the Houston Ship Channel. Designed for an initial throughput of 3,500 bbl. per day, the plant has been processing a 5,000-bbl. charge without difficulty.

Low-gravity, Boscan crude from Venezuela is the principal charge stock, being mixed with some coastal distillate before being charged to the two-stage distillation unit. Plant output



HEAVY BOSCAN CRUDE is processed at the plant and sufficient heating equipment is a must.



BOSCAN CRUDE is mixed with Gulf Coast distillate before processing. This enables Texas Asphalt & Refining Co. to meet the flash specifications when making high-penetration asphalt.

Martens method. This feature makes it difficult to meet the flash specifications when making high-penetration asphalt. To offset this condition, Gulf Coast distillates are mixed with the Boscan prior to distillation.

In the ensuing process, low-flash gas oils are distilled off and distillate remaining in the residuum provides the necessary flash desired in the asphalt product. The distillate has a gravity of about 54° A.P.I. When combined with the crude, the resultant charge has a gravity of 20.4°. Out of 5,000 bbl. charged, 1,430 is distillate and the remaining 3,570 is crude.

Processing . . . The processing setup at Texas Asphalt is straightforward. The combined crude-distillate charge is passed through heat exchangers and a fired heater before entering a flash tower. Light naphtha is removed in the overhead vapors and the heavy bottoms charge is passed through a second heater before entering the crude tower.

The overhead stream from the crude tower is passed to an accumulator operating under vacuum. Part of the stream is returned as reflux, the rest recovered as heavy naphtha. Three individual side strippers are used for pulling off distillates from the tower. The bottoms asphalt product is directed to storage. Asphalt produced amounts to 2,650 bbl. or 53 per cent of the combined charge and 74 per cent of the Boscan crude charge.

The asphalt is heated through use of 450-psi. steam to facilitate handling. The storage tanks for penetration-grade asphalt use an extended fin-tube heater, and each is equipped with an individual rotary pump. The asphalt

TABLE 1—ANALYSIS OF TYPICAL SAMPLE OF BOSCAN CRUDE

Gravity, °A.P.I.	10.1
Vis. S.s.F. at 122° F.	2,700
Vis. S.s.F. at 150° F.	750
Vis. S.s.F. at 180° F.	240
Vis. S.s.F. at 210° F.	97
Pour point, °F.	+50
Sulfur, wt. per cent	5.39
Wax Holde, per cent	1.0
S. and W., per cent	1.0
Reid vapor pressure	less than 0.5
Saponification No.	1.9
Characterization gravity	22
A.S.T.M. distillation	D-86
Start	244
5 per cent	462
10 per cent	550
20 per cent	620

TABLE 2—TYPICAL YIELDS

Charge:	1,430 bbl. 54° A.P.I. distillate
	3,570 bbl. 10.1° A.P.I. crude
	5,000 bbl. 20.4° A.P.I. charge

Yields:	B./S.D.
No. 1 distillate	348
No. 2 distillate	233
No. 3 distillate	507
Light naphtha, i.b.p. 250° F.	608
Heavy naphtha, i.b.p. 430° F.	657
Asphalt	2,650

can be held at any temperature desired by recirculating asphalt through the heater and back into the tank.

Asphalt product is moved via tank truck or barge and space has been provided at the site for two railroad spurs. Each storage tank is connected directly to the truck-loading rack rather than through headers within the tank yard. This permits a great deal of flexibility in storing many grades as asphalt.

The plant was designed and engineered by Pona Engineers, Inc., of Houston, who also were responsible for supervising its construction.

Company officials are A. R. Matthews, president, and F. M. O'Connor, executive vice president. Plant superintendent is D. R. Tillery.

MODERN TRUCK-LOADING rack with provisions for loading a wide variety of asphalt is a feature of the plant.

by W. L. Nelson
Technical Editor

COST-imating

Construction Costs Are Undergoing Inflation

THE Nelson Refinery Construction Cost Index is weighted heavily on the price of steel and on wages. This has caused it to rise (usually) more rapidly than most of the indexes shown on this page because many of the items listed here are not used as extensively as steel in the construction of refinery equipment.

However, between August and November 1956, the indexes shown on this page rose more rapidly than the Nelson Index and more rapidly than the indexes for steel products or labor. Apparently, the cumulative effect of the summer increases in the price of steel and in the wage rates of labor are now being reflected throughout the entire industrial economy. Should this trend be continued, we will undergo a degree of inflation that will be much more serious than in the past.

The cost indexes on this page may be used to convert prices known at any date to prices at other dates or the present, by ratios of the cost indexes of the same dates. Similar itemized cost indexes are published quarterly in the first weekly issues of January, April, July, and October. In addition, the Nelson Refinery Construction Cost Index is published in the first issue each month of The Oil and Gas Journal in the Engineering Section.

Itemized Cost Indexes

(Multiply the 1946 prices of the Cost-imating Series by these Index Numbers divided by 100)

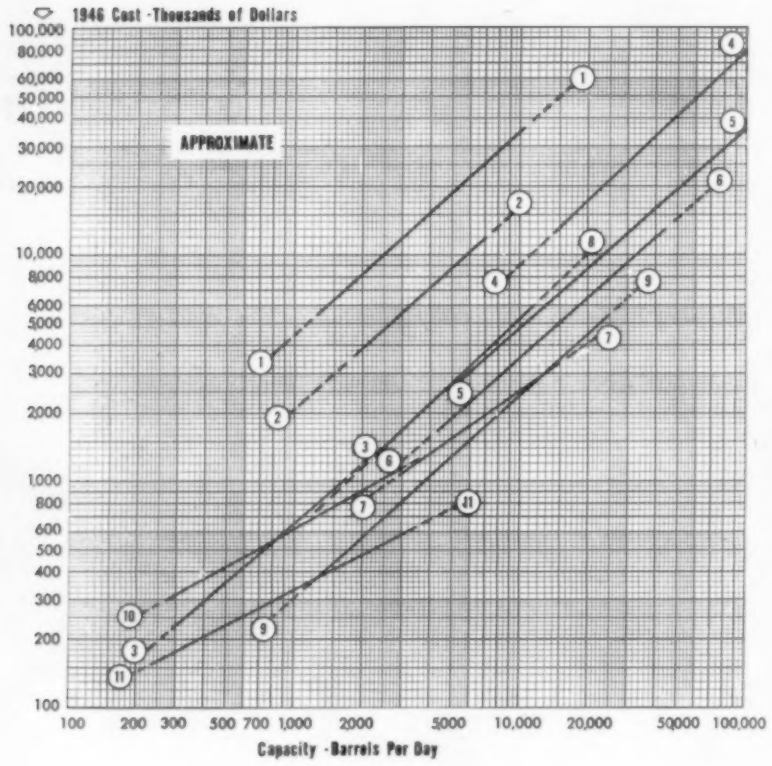
	1948	1950	1952	1954	1956	Nov. 1956	References*	Index for earlier years (The Oil and Gas Journal) in Cost-imating issues
Labor:								
Skilled construction	125.0	140.0	157.9	174.6	187.3	190.7	Eng. News Record	No. 55—Nov. 3, 1949
Common labor	131.0	148.1	168.2	192.1	209.2	212.2	Eng. News Record	No. 55—Nov. 3, 1949
Refinery construction	128.0	144.0	163.1	183.3	198.2	201.5		No. 61—Dec. 15, 1949
Refinery operation	126.0	137.6	155.1	169.5	191.0	192.3	Sur. of current business	No. 55—Nov. 3, 1949
Refinery productivity, bbl. per employe	109.0	125.0	132.0	142.0	146.1	144.2	Sur. of current business	Sept. 24, 1956§
Equipment or materials:								
Arc-welding machinery			151.3	158.4	180.2	185.4	Code ‡11-76	May 2, 1955§
Boilers, tanks, and sheet metal	†140.0	†136.0	†153.4	147.3	168.0	177.1	Code 10-72	April 21, 1952§
Boiler tubes, 2-2¼ in.	131.3	149.5	168.8	199.4	235.5	250.7	Code 10-14-61	Sept. 5, 1955§
Building materials (nonmetallic)	120.6	127.0	134.8	143.6	154.0	155.9	Code ‡13	No. 22—Mar. 17, 1949
Brick—building	122.8	132.5	140.6	144.7	159.2	160.7	Code 13-41	No. 20—Mar. 3, 1949
Brick—fireclay	133.3	153.4	167.1	193.1	218.1	223.6	Code 13-42	May 30, 1955§
Castings (foundry products)	144.6	152.9	168.0	181.1	204.7	215.8	Code 10-15	No. 46—Sept. 1, 1949
Clay products (structural, etc.)	121.3	134.6	145.8	159.1	176.9	179.6	Code 13-4	No. 20—Mar. 3, 1949
Concrete—ingredients	119.4	125.3	132.7	142.1	153.3	154.5	Code 13-2	No. 22—Mar. 17, 1949
Concrete—products	118.9	124.4	132.6	138.5	144.9	147.7	Code 13-3	
Electrical machinery	127.6	134.9	152.4	159.9	175.0	184.0	Code ‡11-7	May 2, 1955§
Motors and generators	128.6	135.0	154.6	157.7	169.6	179.2	Code ‡11-73	No. 31—May 19, 1949
Switchgear			161.4	171.2	194.9	208.3	Code ‡11-75	May 2, 1955§
Transformers	127.0	131.6	148.0	161.9	175.4	185.3	Code ‡11-74	No. 31—May 19, 1949
Engines (composite)	116.0	126.0	146.5	150.5	164.0	171.4	Code ‡11-54	No. 36—June 23, 1949
Exchangers	130.0	140.0	165.8	174.5	190.6	197.8	Manufacturer	No. 2—Oct. 28, 1948
Fans and blowers	131.3	162.9	183.7	192.6	222.4	230.1	Code 11-47	Feb. 17, 1949§
Hand tools	125.2	143.2	155.1	173.8	200.3	207.6	Code 10-42	June 27, 1955§
Instruments (composite)	120.0	127.8	146.2	154.6	182.1	186.2	Manufacturer	No. 34—June 9, 1949
Flow meter (mechanical)		114.0	132.3	161.6	203.3	203.3	Manufacturer	No. 34—June 9, 1949
Flow meter (air control)		138.5	160.5	179.6	203.9	208.2	Manufacturer	No. 34—June 9, 1949
Flow meter (remote)		135.5	155.2	146.5	170.2	170.2	Manufacturer	No. 34—June 9, 1949
Potentiometer, six-point		134.0	151.5	167.2	211.8	229.1	Manufacturer	No. 34—June 9, 1949
Potentiometer, air control		134.1	144.9	150.5	192.3	202.7	Manufacturer	No. 34—June 9, 1949
Pressure controller recorder		135.6	158.4	166.3	187.1	187.1	Manufacturer	No. 34—June 9, 1949
Pressure gage		101.2	108.6	108.6	119.2	119.2	Manufacturer	No. 34—June 9, 1949
Thermometer (recording)		124.0	149.4	152.8	170.2	170.2	Manufacturer	No. 34—June 9, 1949
Control valve		133.3	155.5	162.0	180.9	185.5	Manufacturer	No. 34—June 9, 1949
Lumber (composite)	181.0	193.0	203.2	197.8	214.5	207.5	Code 8-1	No. 7—Dec. 2, 1948
Southern Pine	174.3	176.9	191.2	181.2	195.0	194.5	Code 8-12	No. 7—Dec. 2, 1948
Other soft woods	206.5	230.2	248.5	252.7	266.5	257.8	Code 8-13	
Machinery—general purposes	124.9	136.7	151.8	159.9	183.8	192.0	Code 11-4	Feb. 17, 1949§
Machinery—construction	127.8	140.1	157.5	165.9	187.4	196.1	Code 11-2	
Machinery—oil field	†125.9	†135.8	†149.9	†161.9	179.3	185.1	Code 11-51	Oct. 10, 1955§
Paints—prepared	141.4	140.0	155.7	159.0	169.2	174.3	Code 6-21	May 16, 1955§
Pipe, sewer	110.9	120.7	136.9	140.1	160.5	163.5	Code 13-43	No. 22—Mar. 17, 1949
Pipe, black iron	141.0	160.0	179.0	195.0	233.0	243.9	Code 10-14-56	
Pipe, 6-in. line	†130.0	†159.0	†174.0	†200.5	†241.2	†252.9	Code 10-14-58	Mar. 4, 1957
Pumps, air compressors, etc.	127.0	138.2	155.6	166.5	192.0	203.0	Code ‡11-41	No. 29—May 5, 1949
Steel (iron and steel)	141.1	152.9	168.5	179.6	209.0	219.5	Code 10-1	No. 61—Dec. 15, 1949
Steel—finished steel	135.7	153.7	170.0	187.1	212.4	221.2	Code 10-14	July 25, 1955§
Plate	131.0	152.3	163.1	187.0	215.9	225.0	Code 10-14-26	Mar. 4, 1957§
Structural shapes	145.0	162.7	176.2	193.4	219.1	229.3	Code ‡10-14-31	No. 18—Feb. 17, 1949
Valves and fittings	†125.9	†135.8	190.8	197.1	231.9	238.8	Code ‡11-49 (1-6 & 11-14)	No. 46—Sept. 1, 1949
Nelson Refinery Construction	132.5	146.2	163.6	179.8	‡195.3	199.9		No. 61—Dec. 15, 1949

*Code refers to the revised index code number of the Bureau of Labor Statistics, U. S. Department of Labor, "Wholesale Prices." †Estimated base value for 1946. ‡Not exactly the same items as those published before July 7, 1952. §Questions on Technology, The Oil and Gas Journal. ‘Preliminary.

27. Over-All Plant Costs—

Refineries, Reforming, etc. (Approximate)

by W. L. Nelson
Technical Editor



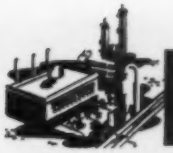
NELSON REFINERY CONSTRUCTION COST INDEX*

	Material	Labor	M&L
1946	100	100	100.0
1947	122	113	117.0
1948	139	128	132.5
1949	144	137	139.7
1950	149	144	146.2
1951	164	152	157.2
1952	164	163	163.6
1953	172	174	173.5
1954	175	183	179.8
1955	176	190	184.2
1956 est.	192	198	195.6

*The Oil and Gas Journal, July 7, 1952, p. 105. The Index also appears in the first issue each month and in addition, indexes for many items of equipment are published in the first issues of the months of January, April, July, and October.

Curve	Type of operation—	Basis	No. of plants or references
1	Lubricating-oil manufacture*	Bbl. per day product	Over 14
2	Benzene and toluene recovery,† large plants	Bbl. per day C_6 and C_7	Over 10
3	Benzene and toluene recovery,† small plants	Bbl. per day C_6 and C_7	Over 11
4	Refinery, complete, all types of products	Bbl. per day feed	Over 150
5	Refinery, complete, cat. cracking, cat. reforming, and poly	Bbl. per day feed	Over 150
6	Refinery, complete, thermal cr., cat. reforming, and poly	Bbl. per day feed	Over 150
7	Refinery, complete, asphalt manufacture	Bbl. per day feed	Over 150
8	Reforming, catalytic, with aromatics‡	Bbl. per day feed	Over 12
9	Reforming, catalytic, incl. feed preparation‡	Bbl. per day feed	Over 70
10	Clay treating, percolation with regeneration	Bbl. per day feed	Over 5
11	Clay treating, contacting	Bbl. per day feed (lube)	Over 5

*Separation of raw stocks, solvent extraction (also often propane deasphalting), dewaxing, treating for color, wax finishing and packaging. †Apparently includes more operations than Curve 3 for small plants. ‡Mainly Platforming and platinum-catalyst processes.



JOB IMPROVEMENT FOR THE PROCESS FOREMAN—83

Recommended Procedure for Exchanger Use

CORROSION can definitely become a maintenance problem with heat-exchange equipment and must not be considered lightly. However, because of the scope of the subject of corrosion, it will not be discussed in this writing further than to say that those concerned with this equipment must be ever mindful of the importance of corrosion prevention.

Maintenance . . . Engineering design and process development are not and cannot be expanded to remove the need for maintenance. They can only reduce this requirement. The equipment operator is in a position to make a substantial contribution to reduced maintenance and improved operating efficiency. By recognizing proper operating procedures and realizing the effect of incorrect procedures on equipment life, the operator can prevent material failure and equipment inoperability.

Recommended Procedures

A few examples of recommended procedures by which the operator can help to reduce maintenance and extend the life and efficiency of exchangers are:

1. Maintain proper cooling water outlet temperature (not in excess of 125° F.).

Failure to observe this recommendation may result in: (a) excessive scaling of tube wall, (b) accelerated corrosion of exchanger parts, and (c) produce mechanical failure of exchanger in tube rolls.

2. Avoid introducing a high-temperature stream into an exchanger before circulation of the cooling medium has been established. This is to prevent undue stress on the metals.

3. Maintain adequate flow rates through exchangers to wash fouling media from the bundle and maintain heating rates within the limits of thermal design to prevent overheating.

4. Operate within mechanical-design limits to prevent overstress of metals.

5. Utilize steam traps on steam heaters to maintain maximum steam pressure within the exchanger. Bypassing traps results in excessive steam consumption and reduced over-all transfer coefficient.

6. Guard against the use of superheated steam in exchangers designed for saturated steam heat. Superheated steam in such tube bundles reduces the over-all transfer rate 10 times and may result in overheated equipment.

Proper testing of repaired heat-exchange equipment is an important phase of maintenance in that it is a means of assuring operable equipment without the application of excessive pressure. Standard, recommended procedure for hydrostatic testing of exchangers is to apply one and one-half times the design pressure. This is applied to the shell side. Only when the difference between shell and tube-side operating pressures is substantial is this procedure applicable to the tube side.

Water boxes . . . The mechanisms by which heat transmission takes place in a water-box pipe coil is no different than in any other type of process heat exchanger. Because of the adverse velocity conditions in such a cooler or condenser, the over-all transfer coefficient is low, requiring more transfer surface than a corresponding shell-and-tube condenser. Use of the submerged tube nests (previously described) allows some improvement in transfer rate and consequent reduction in size.

Even though such disadvantages do exist, these coolers find wide and well applied use as coolers for high-temperature streams, such as tar, heavy gas oil, etc. Also, a submerged coil offers substantial safety allowance in case of a power failure in that considerable water reserve exists.

Coil Cooler

The recommended procedure for the operation of a water box and coil cooler or condenser is much the same as other heat-exchange equipment. However, in the case of cast-iron coils, it is of extreme importance that thermal shock does not take place. Cast iron, being susceptible to breakage under this condition, can present a safety problem as well as an operating problem.

In addition to susceptibility to breakage, flanged coils can present a maintenance problem in gasket failures. Also, cast iron, as well as steel, can become a corrosion problem if not suitably protected. This can be done with cathodic protection.

Maintenance of this equipment is restricted to corrosion prevention and cleaning. Cleaning of this equipment is simple in that periodic washing of the coils and box is all that is necessary. This is done with a fire hose to remove water residue and scale from the box sides and coil walls.

In the operation and maintenance of all heat-exchange equipment, these points should be kept in mind:

1. Operate at temperature and pressure limits within the scope of the mechanical design.

2. For best results, operate within the limits of thermal design.

3. Seek to prevent overheating of the equipment so as to reduce fouling and extend equipment life.

4. Do not allow thermal shock to occur.

5. Provide ample venting and drainage plus a direction of flow as prescribed by design.

6. Water-box coils should remain submerged at all times.

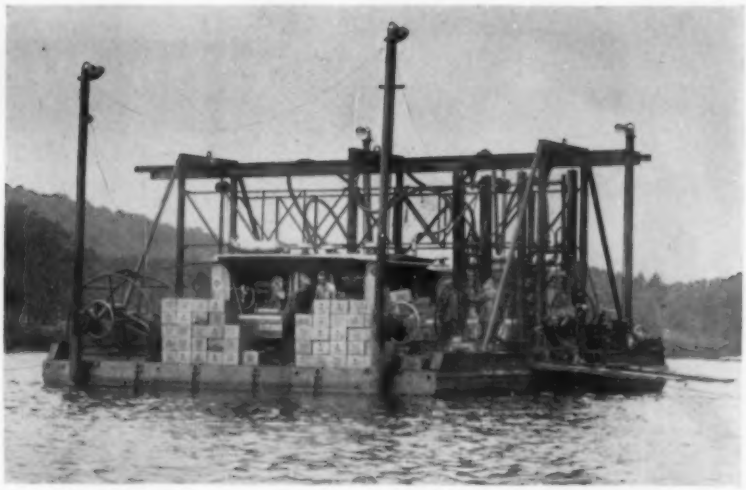
Next—Furnace operation

This material is taken from "Fundamentals of Refining," operating manual of Magnolia Petroleum Co., refining division, Beaumont, Tex.

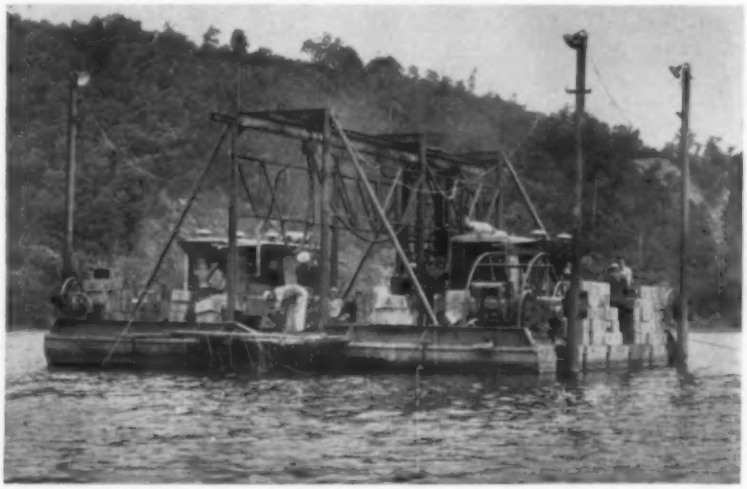
This Is Not A Marine Drilling Barge

. . . It's the hottest thing out to speed pipeline rock river crossings

It works this way→



Floating A-frame mounts two sets of pneumatic drills . . .



Shot holes are filled with dynamite; drilling proceeds

by Paul Reed
Pipeline Editor

A NEW unit for pipelining at inland river crossings looks as though it might have been designed under the influence of ideas for offshore well drilling platforms.

To expedite the drilling of shot holes in rocky river beds, an entirely different type of unit has been developed by J. F. Neill & Co. and C. S. Le Noir & Co. Neill and Le Noir operate as a joint venture known as Western Construction Co., pipeline contractors.

Since it was built for laying a 30-in. crossing for Transcontinental Gas Pipe Line Corp. in 1956 at the Susquehanna River in Pennsylvania, it is called the "Susquedriller."

This is the first application of pneumatic rock drills to shot-hole drilling from floating equipment for a pipeline river crossing. Previously wagon drills had been used at small stream crossings.

It represents the most important advance for the technique of laying pipe across a rocky river. And it is one of the outstanding innovations in recent years for pipeline construction. It has proved its value in faster construction and lower costs. The new methods developed promise to influence future pipelining across rocky rivers.

Susquedriller basic features . . . Essentially the Susquedriller is a floating A-frame mounted between two barges from which two sets of twin pneumatic drills are suspended. Compressors and other equipment are carried on the barges on each side. The drilling equipment moves the entire 40-ft. length of the overhead I-beam.

Drilling time is estimated to be a third to a quarter of that taken by the usual cable-tool spudder method. And the trench can be dug to follow the engineers' survey more accurately.

Offshore-type drilling . . . Like a seagoing portable well-drilling platform, the Susquedriller has provision for raising its own platform on the spuds. But this upward movement is usually only just enough to equalize the weight of the two barges so that the spuds have a firmer bearing in the river bed.

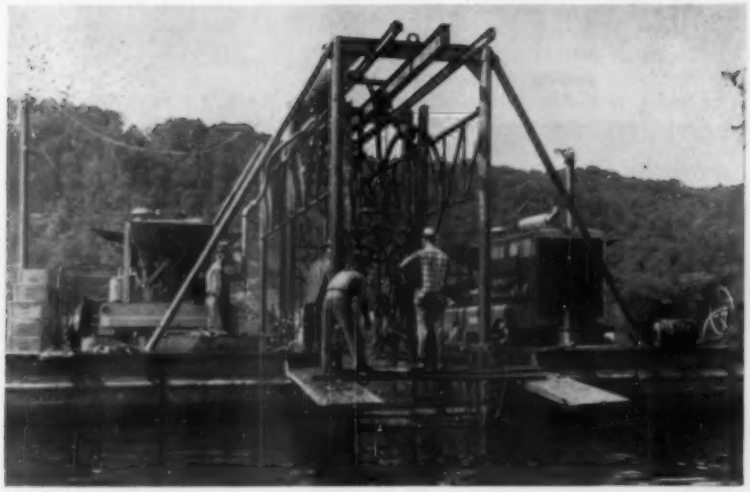
The Susquedriller was designed particularly for operating in a swift river. Still the basic problem resembles that of the offshore drillers.

Problem of rigidity . . . Before laying Transco's Susquehanna River crossing, Charles S. Le Noir decided to make shot holes with pneumatic rock drills if he could devise a means for holding the barges securely during drilling operations. He saw that such a drilling method would be much faster than the usual one of drilling shot holes with cable-tool spudders mounted on barges.

The problem of attaining rigidity was solved by an original design of C. S. Le Noir in collaboration with B. W. Williams and E. J. Price.

Secure positioning of the barges is obtained by means of winches at each of the four spuds. These winches throw weight on the spuds to hold them rigidly. Weights are equalized.

PIPELINING



. . . Drill, shown here in action, drills shot holes. Then

BOOM. Fragmentation excellent. Three shots are needed

And the slight raising of the barge also reduces the effect of the current on the barges.

Susquedriller in brief . . . Here are the main features of the Susquedriller unit:

- Two twin deep-hole pneumatic drill units (each mounted on H-frames) drill the shot holes.
- These are suspended from a 40-ft. I-beam which serves as a track on which they are moved from one drilling position to another.
- This track is supported by an A-frame superstructure mounted on two barges, spaced 6 ft. apart to provide an opening for drilling between the barges.
- Each of the two barges, 30 ft. long and 8 ft. wide, was formed by latching together two smaller barges.
- To insure that the barges are held in a rigid position, a spud is placed at each of the four corners of the main floating two-barge assembly.
- Throwing of the weight on the spuds is accomplished by a hand-operated winch at each spud.
- From one location to another, the barge is jockeyed by anchor lines manipulated by air-powered winches. Only 30 minutes is taken in moving to the next location and starting again.
- On each barge there is a 900-cu. ft. per minute air compressor serving one of the two twin drills. The barges also carry dynamite, primacord, drill steels, tamping steels, and diesel fuel. These together with the weight of the superstructure supporting the drills, weight of twin drill units, and the weight of the barges on both sides of the drilling space amount to a total of 90,000 lb.

The barges draw 2 ft. of water when unsupported by the spuds.

Delta crossing . . . The Susquehanna River crossing is on a Transco loop in the Delta, Pa., area at a point extending from Quarryville, Pa., to Forest Hills, Ind. The unusual width of 4,700 ft. for a rock crossing is due to the fact that it is in an inundated valley between two dams. The crossing is 1½ miles from the Holtwood Dam downstream and 10 miles from the big Conawingo power dam upstream. Average depth of water at the crossing is 14 ft. Water level varied as much as 5 ft., depending on the amount released from the Conawingo Dam. The river has a quartz seam which makes the bottom rough.

From hour to hour close contact was maintained with the power dam so as to anticipate changes in water levels.

Dam break . . . On one occasion, when the upstream dam broke, water rose 11 ft. in 30 minutes. The Susquedriller was flooded, some ditch was washed out, and a 2,600-ft. section of pipe was taken 200 ft. downstream. In flood periods the current reached 8 m.p.h.

The trench was 8 ft. deep and 5 to 10 ft. wide for holding the 30-in. pipe which had an outside diameter of 36 in. due to the concrete jacketing.

The project was complicated by the job of keeping fishing boats away from operations night and day. An effort was made to stop the public from getting within 1,500 ft. of the job.

Drilling . . . The 3,123 shot holes were drilled in 34 days. A five-spot pattern was used with the holes spaced 5 ft. apart in the outside rows. The inside row was staggered, using the same spacing. Average depth of hole in the rock was 10 to 11 ft.

The close spacing was preferred because it produced more fragmentation through greater shattering effect which meant less work in clamming out the ditch afterward. It is cheaper in the end to spend more money on explosives for good shattering.

Holes were 5 in. in diameter for the top 12 in. They were tapered to 4 in. for the rest of the hole. The tapered hole facilitated loading with explosives.

The drills hanging from rollers on the overhead track could be revolved so as to make the center holes in the five-spot. Holes are drilled four at a time.

The "drill steel" was of "locked-in construction." This meant that addi-

tional lengths could be quickly coupled.

Timken carbide 4-in. detachable bits were used in making the drill holes.

In connection with drilling operations, drill steel was fed and lifted by an air motor operated chain drive.

The hole was cleaned by compressed air injected through a blow pipe.

Drilling was completed in the 34 days shortly before the big shooting on August 10, 1956. Drilling and some of the clamming was done in two 12-hour shifts working around the clock.

Casing . . . While the shot holes averaged 10 to 11 ft., casing often varied 10 to 26 ft. in length, because of changing water depth. Casing lengths of 10 to 12 ft. were added to reach required depths. Casing was lightweight pipe ($\frac{3}{16}$-in. wall thickness). Diameter of the casing was 5 in. at the top. It tapered to 4 in. for the bottom 12 in. where it fitted into the top of the shot hole.

Tops of casing were held in square slots in the frame hung at water level between the barges. This method of holding the casing served a double purpose: it kept the casing vertical and maintained correct spacing between holes without the need of measuring.

After the holes were loaded with dynamite, casing was pulled by a chain hoist on the superstructure.

Shooting . . . A charge of 50 lb. of 80 per cent gelatin in fourteen 3 by 12-in. cartridges was used in each drill hole. This gelatin could stay in water 60 days. The gelatin was packed in a light wrapper so that upon tamping it would easily fill the width of the borehole. Tamping of gelatin was done on the bottom 2 ft. to increase fragmentation. Plastic reinforced primacord was the detonating agent.

The primacord from each hole was attached to small wooden floats which were small enough to pass through the casings when they were withdrawn after the explosives-loading operations were completed. A copper shell was crimped to both ends of the primacord to retard the absorption of water. The holes in one row had yellow painted floats, another had red, and the third had unpainted floats.

This provided positive identifications when connecting the branch lines of primacord into the trunk line leading to the shore. Enough primacord had to be furnished to match the rise and fall of the water. Metal clips, used to make these connections, assured contact without breaking the plastic coating on the primacord trunk line. The shot was fired by the blasting-cap and safety-fuse method.

In the first shot of 110 ft., considered a test shot, a loading factor of 20 lb. per cu. yd. was used. Fragmentation was excellent and no large pieces of rock were encountered in the mucking operations. There were two experimental blasts to determine width and fragmentation. It was decided to increase the charge in each hole to throw more of the rock out of the trench and speed up the mucking cycle.

The entire crossing was blasted with three big shots on August 10, 1956. Mucking was done with clam bucket. The heaviest shooting was upstream. No secondary blasting was required.

BOOKS

ANALYSIS BY LOW TEMPERATURE DISTILLATION. Published by the Natural Gasoline Association of America, 421 Kennedy Building, Tulsa 3. $8.

This book gives the theory and outlines the practical knowhow needed to operate a low-temperature fractional distillation apparatus properly. It should prove very helpful in the majority of laboratories where analysis by such columns will remain the "referee" method for years to come.

It is an outgrowth of cooperative studies of methods and apparatus. These studies were sponsored by the Natural Gasoline Association of America over the period, 1948-57. More material for the book became available as the result of a special University of Oklahoma course in fractional analysis. It is a detailed summary of all that has been learned from these various activities.

Chapter headings are: (1) Basic Principles and Theory, (2) Low-Temperature Fractional Distillation Equipment, (3) Operating Techniques, (4) Calculation of Results, (5) Reanalysis and Auxiliary Techniques, (6) Equipment Maintenance and Laboratory Safety, and (7) Appendices.

PROPERTIES OF PETROLEUM RESERVOIR FLUIDS, by Emil J. Burcik, published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 190 pp. $7.50.

This book is designed to provide instructional matter for a one-semester petroleum engineering course. The material is used at Pennsylvania State University in a course prerequisite to advanced reservoir engineering. Beginning with a summary of petroleum chemistry and properties, the book covers behavior of gases, phase behavior of liquids and hydrocarbons, reservoir-fluid characteristics, and elementary reservoir problems. Also included are practical charts for compressibility factors, equilibrium constants, and temperature and pressure effects on gas solubility, formation volume factor, and density and viscosity of hydrocarbons. Problems are presented after each chapter.

EXPLORATION FOR NUCLEAR RAW MATERIALS. Edited by Robert D. Nininger. Published by D. Van Nostrand Co., Inc., 120 Alexander Street, Princeton, N. J. 282 pp. $7.50.

The editor has compiled this compact, definitive, and carefully organized volume, dealing with the methods and techniques of prospecting for nuclear metals from material gathered from 26 countries.

In logical sequence, the subject is developed through the basic principles of nuclear geology to geologic, geochemical and geophysical techniques of prospecting.

Details of surface, subsurface, and aerial radiometric methods are included. Special emphasis on uses of radiometric methods in the United States, the U.S.S.R., Canada, and Brazil is made. Carefully selected references for the principal subjects supply an invaluable guide to relevant existing literature.

This book wil be of immediate use to scientists, engineers, and industrialists working the field and of course to students and teachers.

Note: The Oil and Gas Journal maintains a book department. Write to the READER SERVICE DEPARTMENT, P. O. Box 1260, Tulsa 1, for copies of the book list. Often books reviewed here may be purchased from this source.

Nelson Refinery Construction Index

Appears in the Engineering Section in the first issue each month.
Compiled by W. L. Nelson, petroleum refinery consultant, Tulsa.
The Index was explained October 1, 1956, (page 110) as well as the Indexes of Individual Items of Equipment that appear on the Cost-imating page in the first issues of the months of January, April, July, and October.

Index (1946=100)

	1949	1952	1954	1955	1956	Dec. 1956
Pumps, compressors, etc.	135.9	155.6	166.5	172.2	192.0	203.1
Electrical machinery	130.9	152.4	160.0	162.5	175.0	184.2
Internal-combustion engines	124.8	146.5	150.5	153.2	164.0	171.7
Instruments	123.1	146.2	154.6	162.9	182.1	186.2
Heat exchangers	133.0	165.8	171.7	156.8	†190.6	†199.0
Miscellaneous equipment average	*121.6	153.3	160.7	161.5	†180.5	†188.8
Materials component	143.6	164.3	174.6	176.1	†190.4	†198.2
Labor component	137.1	163.1	183.3	189.6	198.2	201.5
Nelson construction index	139.7	163.6	179.8	184.2	†195.3	†200.2

*Used in computing the Nelson Index until April 1952. This is slightly different from the average of the Miscellaneous Equipment Items shown above. †Preliminary.

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HOW BELL SYSTEM COMMUNICATIONS SERVE THE PIPELINE INDUSTRY

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Why communications have to be good on Pacific Northwest's "scenic-inch" line

Pumping gas over mountain passes across 1487 miles of America's toughest terrain requires the most reliable communications available.

Pacific Northwest Pipeline Corp. presented this requirement to the Bell System, with one additional request—economy.

The result is a private line telephone system that PNW's Salt Lake City control center uses to keep a running summary of conditions along the line. Information gathered in Salt Lake City from each compressor station includes dew point, BTU content and specific gravity of the gas. Dispatchers use this data as guidance in controlling flow.

• • •

Bell System communications can work for you as fast and reliably. Just call your Bell Telephone Company business office. A representative will gladly discuss your requirements.

Pacific Northwest's Salt Lake City dispatchers collect data hourly from every compressor station and maintenance point on the company's 1487-mile pipeline.

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Pipeline Patrol

. . . Report on Construction

PIPELINE activity reported here is compiled from surveys conducted by The Oil and Gas Journal among pipeline companies and contracting firms. Projects listed include those proposed, contracted, and under way. Uncontracted projects are indicated by • preceding the project.

U.S. Crude-Oil Pipelines

• **Cape Pipe Line Co.** (organized by Sun Oil Co., Cities Service Co., Atlantic Refining Co.)

Project: Long range plans for line on the lower Delaware Bay to the Philadelphia refining area.

Completion: 1960.

• **Four-Corners Pipe Line Co.** (newly formed by Shell Oil Co., Standard Oil Co. of California, Continental Pipe Line Co., Gulf Oil Corp., Richfield Oil Corp., Superior Oil Co.)

Project: 600 miles of line from near Farmington, N. Mex., in the Four Corners area to Los Angeles, to be constructed and operated by Shell Pipe Line Corp. as agent for the companies.

Status: Construction to start in April. Preliminary engineering work under way.

Fulton, R. H. & Co., Lubbock, Tex.

Project: 39 miles of 6-in. from Donkey Creek field in northeastern Wyoming, southeast to the Osage pump station in Weston County.

Status: Fulton, a contractor has applied to Wyoming Public Service Commission.

• **Interstate Oil Pipe Line Co.**

Project: 5 miles of 4-in. from South Bosco field, Louisiana, to present main line, and 5 miles of various size from Church Point field, Louisiana, to present main line.

Status: Proposed.

• **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)

Project 80 miles of 8-in. and 300 miles of 10-in. crude and products line from Four Corners area to Salt Lake City.

Status: To start May 1957.

Completion: August 1957.

• **Offshore Gathering Corp.,** Houston.

Project: 364 miles of mostly 20-in. in Gulf of Mexico off Louisiana. (Dual line.)

Status: Proposed.

Pasotex Pipe Line Co.

Project: 127 miles of 20-in. along its route from Wink to El Paso, retiring another dual 8-in. section.

Status: Under way.

Contractor: **R. H. Fulton & Co.**

Completion: July 1. 1957.

• **Shamrock Oil & Gas Corp.**

Project: 35 miles of 6-in. to serve fields in Ochiltree and Hansford counties in the Texas Panhandle.

Status: Plans to start building in March or April 1957.

Shell Oil Co.

Project: Undetermined length of 3, 4-in. in South Louisiana.

Status: Under way.

Contractor: **Brown & Root, Inc.,** W. P. Stanley, spread superintendent, office at Buras, La.

Completion: September 30, 1957.

• **Sinclair Pipeline Co.**

Project: 150 miles of 20-in. from Teague, Tex., to Houston.

Status: Planned for 1958.

Completion: 1958.

• **Tecumseh Pipe Line System** (Joint venture of Sinclair Pipe Line, Ashland Oil & Refining, and Pure Oil Co.)

Project: 190 miles of 20-in. between Griffith, Ind., and Cygnet, Ohio.

Status: Preliminary work under way.

Completion: September 1957.

Texas Co.

Project: 60 miles of 10-in. gathering lines at Aneth field in southeastern Utah.

Status: Under way.

Contractor: **Ted Price Construction Co.**

Completion: Late April 1957.

• **Texas-New Mexico Pipe Line Co.** (owned by The Texas Co., Sinclair Pipe Line Co., Tidewater Oil Co., and Empire Gas & Fuel Co.)

Project: 515 miles of 16-in. from southeast corner of Utah to Jal in southeastern New Mexico.

Status: Field surveys began January 1957.

U.S. Products Pipelines

• **Alaska-Yukon Refiners & Distributors, Ltd.**

Project: Two lines: one 150 miles from Haines to Haines Junction, Alaska, linking with government Canal line; another from Tok Junction, on the Canal line, to Anchorage.

Status: Proposed.

Completion: 1959.

• **American Pipe Line Co.**

Project: Line from Gulf Coast to New York City area. Received ODM approval to amortize 40 per cent of $175,000,000 cost with a rapid writeoff.

Status: Proposed.

Buckeye Pipe Line Co.

Project: Conversion of 116 miles of 8-in. crude to products between Huntington, Ind., and Griffith, Ind.

Status: Planned.

Contractor: **Sheehan Pipe Line Construction Co.,** C. M. Brown, superintendent, office at Rochester, Ind.

Completion: Fall 1957.

Project: Conversion of 32 miles of 8-in. crude to products between Mantua, Ohio, and Youngstown area.

Status: Planned.

Contractor: Company will do own work.

Completion: November 1957.

• **Cities Service Pipe Line Co.**

Project: 29 miles of 6-in. ethylene line from Lake Charles, La., to Orange, Tex.

Status: Planned.

Completion: July 31, 1957.

• **Continental Pipe Line Co.**

Project: Conversion of 99 miles of 6-in. from the Wichita Falls area to near Fort Worth, Tex., plus a 15-mile extension of the line to the Grapevine area northeast of Fort Worth.

Status: Conversion under way. Extension planned.

• **El Paso Natural Gas Co.**

Project: 11 miles of 4-in. L.P.G. products from Snyder Line to South Andrews Plant, Texas.

Status: Planned.

Project: 240 miles of 6-in. from Odessa to El. Paso, Tex.

Status: Planned.

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OIL STATES EQUIPMENT COMPANY
Houston, Texas
OSECO Silvertop Fusible Plugs with renewable inserts for all types OIL COUNTRY BOILERS.

THE GORMAN-RUPP COMPANY
Mansfield, Ohio
Centrifugal Pumps.

STEEL FORGINGS, INC.
Shreveport, La.
Weld Saddles.

HARRISBURG STEEL CORPORATION
Harrisburg, Pennsylvania
Forged Steel Flanges and Seamless Welding Couplings.

VOLCANO BURNER COMPANY
Houston, Texas
Volcano Superior and Gulf States All Steel Gas Burners for OIL COUNTRY BOILERS.

LOS ANGELES BOILER WORKS, INC.
Los Angeles, California
Welding Caps—Dished & Flanged Heads.

WESTERN SAFETY BARREL STAND
Houston, Texas
Stand lifts, holds, tilts 55 gal. barrels Prevents spillage—easily loaded.

MILLS IRON WORKS, INC.
Los Angeles, Calif.
Seamless Swage Nipples, Bull Plugs & Welding Reducers.

WHEELING MACHINE PRODUCTS CO.
Wheeling, West Virginia
XL Steel Pipe Couplings for OIL COUNTRY TUBULAR PRODUCTS.

Pipeline Patrol

Contractor: **Pipeline Engineering Co.** has design and engineering contract.
Completion: Early 1958.

Engineering Management, Inc.
Project: 58 miles of 10-in. from Richmond to Castle, Calif.
Status: Under way.
Contractor: **Hood Construction Co.**, William Burgess, spread superintendent, office at Sacramento.
Completion: July 1, 1957.

• **Great Lakes Pipe Line Co.**
Project: 84 miles of 8-in. from south of St. Paul to Eau Claire, Wis.; 68 miles of 12-in. from Great Lakes intersecting point with Badger Pipe Line to Chicago.
Status: Construction scheduled to start spring 1957.

• **Gulf Refining Co.**
Project: 530 miles of 10-in. L.P.G. and natural gasoline line from Waddell Plant in Crane County, Texas, to Mont Belvieu near Houston (368 miles is conversion from crude service).
Status: Under way.
Contractor: **Panama-Williams Corp.** has 46 miles from Waddell Plant to Midland. Remainder not let.

• **Laurel Pipeline Co.** (Gulf Refining Co. and Sinclair Pipe Line Co.)
Project: A 24-in. line from the Philadelphia refining area to Cleveland.
Status: Under consideration.

• **Northwest Pipeline Corp.** (an affiliate of Pacific Northwest)
Project: 80 miles of 8-in. and 300 miles of 10-in. products and crude line from Four Corners area to Salt Lake City.
Status: To start May 1957.
Completion: August 1957.

• **Ohio Oil Co.**
Project: 350-miles of 12-in. from Wood River, Ill., to Chicago.
Status: Work to start fall 1957.
Completion: 1958.

• **Southern Pacific Pipe Lines, Inc.**
Project: 100 miles of 10-in., 80 miles of 8-in., and 125 miles of 6-in. between Richmond, Calif., and Fallon, Nev.
Status: Under way.
Contractor: **River Construction Corp.** has 84 miles of 8, 10-in. from Richmond to Stockton, Calif. to complete late spring 1957, F. O. Traweek, spread superintendent, office at Richmond. **Hood Constructtion Co.**, Lynwood, Calif., has 58 miles of 10-in. from Stockton to Roseville, Calif. **Engineers, Limited Pipeline Co.** and **Joe E. Young Pipe Line Construction Co.** have 18 miles of 6 and 4-in. between Roseville and Donner Summit.
Completion: August 1, 1957.

• **Union Oil Co. of California**
Project: 815-mile line from Rifle, Colo., to Los Angeles refining area, to carry products from its proposed Rifle shale-oil plant.
Status: Proposed.

U.S. Natural-Gas Pipelines

• **American Louisiana Pipe Line Co.**
Project: 7 miles of 16-in. and 5 miles of 12-in. at North Holly Beach Field and Second Bayou Field, Cameron Parish, La.
Status: Has temporary FPC permit.

• **Arkansas Louisiana Gas Co.**
Project: A 300-mile line from Texas-Louisiana coastal region to northern Louisiana, to connect with their present system, plus gathering lines.
Status: Long-range plans.

Carolina Pipeline Co.
Project: 177 miles of 2, 3, 4, 6, 8, and 10-in. between Blacksburg and Camden, S. C.
Status: Work to start June 1, 1957.
Contractor: **Panama-Williams Corp.**

• **Central Hudson Gas & Electric Corp.**

Pipeline Patrol

Project: 46 miles of 10-in. from Albany to Kingston, N. Y.
Status: Planned.
Completion: November 1, 1957.

Cities Service Gas Co.

Project: 8 miles of 16-in., 20 miles of 8-in., 20 miles of 6-in., and 20 miles of 4-in. field lines in Barber County, Kansas.
Status: Approved. Under way.
Contractor: **Vaughn & Taylor Construction Co.**

Project: 3 miles of 12-in., 8 miles of 10-in., 4 miles of 8-in., 8 miles of 6-in., and 37 miles of 4-in. field lines in Eureka Field, Okla.
Status: Approved. Under way.
Contractor: **Vaughn & Taylor Construction Co.**

Project: 4 miles of 16-in. at Sarcoxie, Mo.
Status: Approved. Under way.
Contractor: **Prairie Construction Co.**

Project. 64 miles of 6 to 30-in. in Leavenworth and Anderson counties, Kansas, Cass County, Missouri. and Oklahoma County, Oklahoma.
Status: Planned.

• **Coastal Transmission Corp.**

Project: 575 miles of 12, 20, 22, 24-in. main line and 414 miles of 2 to 14-in. gathering lines between McAllen, Tex., and Baton Rouge, La.
Status: Has FPC approval.
Completion: January 1, 1958.

• **Colonial Natural Gas Corp.**

Project: Two systems; one between Houston-Lake Charles area and Miami, Fla.; one in the Carolinas and Georgia.
Status: Proposed.

• **Colorado Interstate Gas Co.**

Project: 1957 program . . . 66 miles of 30-in., 40 miles of 34-in., 109 miles of 26-in., and 100 miles of 24-in. from Springfield, Colo., to Pueblo, Colo; 345 miles of 30-in. from Kit Carson, Colo., to Beatrice, Neb.; 50 miles of 22-in. from Laverne to Hooker, Okla.; 24 miles of 22-in. Panhandle field looping.
Status: Pending FPC approval.

Project: 139 miles of 4 to 24-in. from Mocane to Hooker, Okla.
Status: Under way.
Contractor: **Panama, Inc.** Spread offices will be at Beaver City and at Mocane, Okla.
Completion: May 15, 1957.

• **El Paso Natural Gas Co.**

Project: 338 miles of 34-in. from San Juan and Permian basins to California border.
Status: Under way.
Contractor: **R. H. Fulton Co.** has 102 miles; **Western Pipeline, Inc.,** has 144 miles; El Paso will construct remaining 92 miles.
Completion: April 1957.

Project: 74 miles of 34-in. San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: August 1957.

Project: 81 miles of 18-in. from Panoma Plant, Gray County, to Dumas Plant, Moore County, Texas.
Status: Planned. Filed for FPC permit.
Completion: July 1957.

Project: 177 miles of 20-in. from Sonora Plant, Sutton County, to Plains Plant, Yoakum County, Texas.
Status: Planned. Filed for FPC permit.
Completion: January 1958.

Project: 74 miles of 30-in. Permian-San Juan main line loops.
Status: Planned. Filed for FPC permit.
Completion: January 1958.

Project: 216 miles of 6 to 34-in. in Arizona, Texas, and New Mexico, plus 533 miles of various size line.
Status: Filed for FPC permit.

Fish Service & Management

Project: 300 miles of 2 to 10-in. distribution lines at Boise, Idaho.
Status: Under way.
Contractor: **Hood Construction Co.,** C. R. Shearman, spread superintendent, office at Boise.
Completion: April 30, 1957.

Houston Texas Gas & Oil Corp.

Project: 702 miles of 24-in. from Baton Rouge, La., to Kissimmee, Fla.; 240 miles of 18-in. from Kissimmee to Cutler, Fla.; 642 miles of 3 to 18-in. sales laterals in Florida. Main line to join Coastal Transmission's proposed line from McAllen, Tex., to Baton Rouge.
Status: Planned. FPC certificated.
Contractor: **Midwestern Constructors** has the 702 miles of 24-in.; **Harbert Construction Corp.** has remainder.
Completion: June 1958.

• **Iron Ranges Natural Gas Co.,** St. Paul.

Project: 68-mile transmission line and 47 miles of laterals to supply towns on the Mesabi Iron Range, Minn.
Status: Application pending with FPC.

• **Kansas-Nebraska Natural Gas Co.**

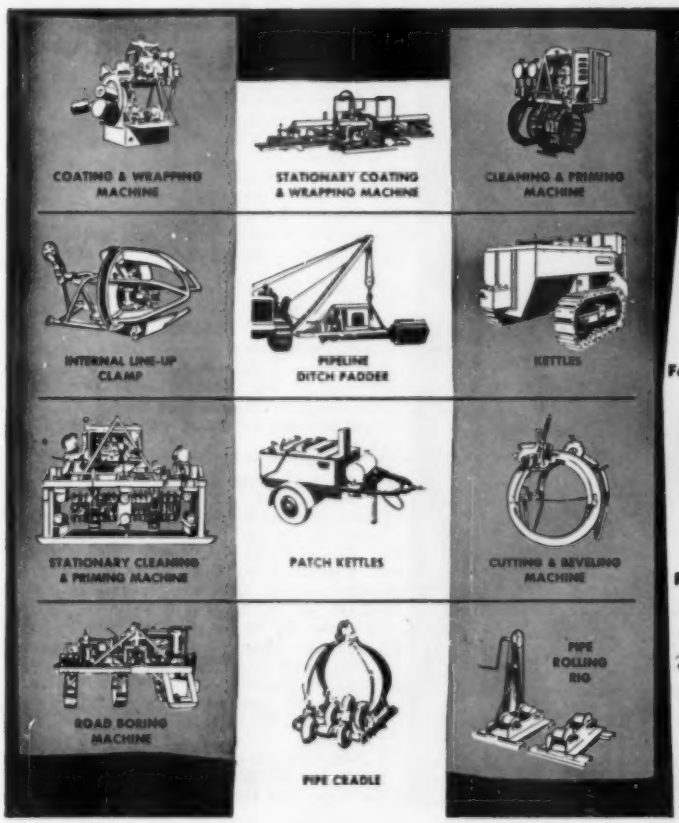
Project: 61 miles of various size gathering line in Camerick field, Texas County, Oklahoma.
Status: Approved.

Project: 10 miles of 10-in. between Grand Island and Fullerton, Nebr.
Status: Approved.
Completion: May 1, 1957.

Project: 12 miles of 12-in. between Scott City and Colby, Kans.
Status: Approved.
Completion: May 1, 1957.

Michigan Consolidated Gas Co.

Project: 67 miles of 10 and 12-in. between Sears and Travers City, Mich.
Status: Under way.
Contractor: **Somerville Construction Co.;**



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Pipeline Patrol

Floyd Huduall, spread superintendent, office at Cadillac, Mich.

Project: 60 miles of 10 and 12-in. between Muskegon and Ludington, Mich.

Status: Under way.

Contractor: **Somerville Construction Co.,** jointly with **J. L. Gentry Construction;** Frank Morris, spread superintendent, office at Hart, Mich.

• **Michigan Wisconsin Pipe Line Co.**

Project: 24 miles of 24-in. and 16 miles of 4-in. looping in Michigan, Indiana, Illinois, Wisconsin, Iowa, and Missouri.

Status: Approved.

Completion: 1957.

• **Midwestern Gas Transmission Co.**

Project: Will build main line from Portland, Tenn., to Canadian border near Emerson, Man.; 829 miles of 24-in., 109 miles of 16-in., 174 miles of 12-in., 648 miles of 3 to 18-in. extensions in Minnesota and Wisconsin.

Status: Application pending with FPC.

• **Mississippi River Fuel Corp.**

Project: 125 miles of loops along portions of present lines from fields in Louisiana and eastern Texas, to St. Louis.

Status: Planned.

• **Mountain Fuel Supply Co.,** Salt Lake City.

Project: 38 miles of line to connect with Pacific Northwest Pipeline Corp.'s system in Sweetwater County, Wyoming.

Status: Has temporary FPC permit.

• **Natural Gas Pipeline Co. of America**

Project: 350 miles of 20 and 26-in. from Jack and Wise counties, Texas, to Fritch, Tex.

Status: Has FPC approval.

Contractor: **R. H. Fulton & Co.** has Red River crossing in northern Montague County.

Completion: Total project to be completed by January 1, 1958.

Project: 389 miles of 36-in. loops along its line from Beatrice, Neb., to Chicago, to take gas from proposed line of Colorado Interstate Gas Co., and for 91 miles of 30-in. loops along parts of its main line.

Status: Application pending with FPC.

• **Niagara Mohawk Power Corp.**

Project: 14 miles of 18-in. from Phoenix to Palermo, N. Y.

Status: Planned.

Completion: October 1, 1957.

Project: 261 miles of 2 to 16-in. transmission and distribution mains to service areas in central, eastern and northern New York state.

Status: Planned.

Contractor: Various.

Completion: December 31, 1957.

• **North Carolina Natural Gas Corp. (Subsidary of Colonial Natural Gas Corp.)**

Project: 575 miles of 3 to 16-in. from Transcontinental Gas Pipe Line Corp.'s system near Mooresville, eastwardly across north Carolina.

Status: Has FPC permit.

• **Northern Natural Gas Co.**

Project: 160 miles of 2, 3, 6, 8-in. branch lines to serve 20 new communities on Aberdeen, S. D., line.

Status: Under way.

Contractor: **Troth Construction Co.**

Project: 73 miles of 20-in. from Savana Creek to Pincher Creek fields in Alberta, Canada; 32 miles of 24-in. from Pincher Creek to Montana border; 1,100 miles of 26-in. from Montana into Minneapolis.

Status: Planned.

• **Offshore Gathering Corp.,** Houston.

Project: 364 miles in Gulf of Mexico off Louisiana.; 60 miles of 24-in., 70 miles of 26-in., 234 miles of 30-in. (Dual line.)

Status: Application pending with FPC.

• **Ohio Fuel Gas Co.**

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Pipeline Patrol

Project: 7 miles of 12-in. near Fremont, Ohio.
Status: Planned.
Completion: First half 1957.
Project: 23 miles of 18, 20-in. from Gibsonburg to Toledo.
Status: Uncertain.
Project: 152 miles of line in Ohio: 38 miles of 24-in. from Crawford Station to Utica; 18 miles of 24-in. from Pavonia Station to Line D; 6 miles of 20-in. from Mount Gilead to Claridon; 4 miles of 20-in. near Dayton; 4 miles of 20-in. near South Charleston; 7 miles of 16-in. near Springfield; 6 miles of 20-in. nnear Oberlin; 17 miles of 20-in. from Oak Hill to Symmes Station; 7 miles of 12-in. from Mount Sterling to Bloomingburg; 2 miles of 8-in. near Bellefontaine; 3 miles of 12-in. near Mansfield; 4 miles of 12-in. near Lakeville; 7 miles of 8-in. in Guernsey and Belmont counties.
Status: Planned.
Completion: Second half 1957.

• **Pacific Gas & Electric Co.**
Project: 37 miles of 20-in., 37 miles of 18-in., 3 miles of 16-in. from Beehive Bend field near Willows, Calif., to near Davis, then to Sacramento.
Status: Under way.
Contractor: **Engineers Limited Pipeline Co.**
Completion: June 1957.
Project: 138 miles of 34-in. looping of the Topock-Milpitas line.
Status: Planned.
Completion: December 1, 1957.
Project: 5 miles of 16-in., 160 miles of 12-in., 8 miles of 6-in. from Corning to Eureka, Calif., to connect company's Humboldt Division with integrated gas system.
Status: Planned.
Completion: January 1958.
Project: 13 miles of 12-in., 2 miles of 10-in., from Santa Cruz to Davenport, Calif.
Status: Planned.
Completion: October 1957.

• **Pacific Northwest Pipeline Corp.**
Project: 37 miles of 6-in. from Dove Creek to Nucla, Colo., and 13 miles of 4-in. from Nucla to Urvan, to serve Union Carbide Nuclear Co. and Vanadium Corp. of America.
Status: Has FPC permit.
Project: 1,000 miles of gathering lines and aterals along present line.
Status: Planned.
Completion: 1957.

• **Pennsylvania Gas Co.**
Project: 23 miles of 10-in. in Erie County, Pa., 15 miles of 8-in. in Warren and Chautauqua counties, Pennsylvania, 30 miles of branch lines and a number of small distribution systems.
Status: Has FPC permit.

• **Peoples Natural Gas Co.**
Project: 58 miles of 2 to 14-in. extension and replacement lines in Pennsylvania.
Status: Work to start April 1957.
Completion: September 1957.

• **Permian Basin Pipeline Co.**
Project: 83 miles of 16-in. from its Spraberry station in Midland County, Texas, to tie in with Pioneer Gathering System, Inc., at a point in northwestern Schleicher County, Texas.
Status: Filed for FPC approval.

• **Phillips Petroleum Co.**
Project: 6 miles of 16-in. in Gray County, Texas.
Status: Under way.
Contractor: **Arey Construction Co.**
Completion: May 1, 1957.
Project: 3 miles of 24-in. in Moore County, Texas.
Status: Planned.
Completion: October 1, 1957.
Project: 30 miles of 3 to 8-in. in Moore, Hutchinson, Sherman, Hansford, and Gray counties, Texas, and in Texas County, Oklahoma.
Status: Planned.
Contractor: Various.
Completion: January 1, 1958.

• **Piedmont Gas Co.**, Hickory, N. C. (Parent is Carolina Natural Gas Corp.)
Project: 78 miles of 2 to 8-in. extension off Trancontinental in North Carolina to serve Gaston, Lincoln, Catawba, Caldwell, and Burke counties.
Status: Application pending with FPC.

• **Pioneer Gathering System, Inc.**
Project: 27 miles of 16-in. and 27 miles of 12-in. in Schleicher and Sutton counties, Texas.
Status: Filed for FPC approval. Estimate to start work March 1, 1957.
Completion: July or August 1957.

Southern California Gas Co. and Southern Counties Gas Co. of California.
Project: 241 miles of 30-in. from the outskirts of Los Angeles to Topock on the Arizona-California border.
Status: Under way.
Contractor: **R. H. Fulton & Co.**
Completion: June 30, 1957.

• **Southern Natural Gas Co.**
Project: 10 miles of 8-in. laterals in Napoleonville Field and Fort Jackson Field, La.
Status: Has FPC approval.
Completion: December 1, 1957.
Project: 32 miles of 6-in. from Chandeleur Sound area, Breton Island, La.; 7 miles of 8-in. and 5 miles of 10-in. from Main Pass area to Olga, La.; 9 miles of 8-in. from Bastian Bay Field to Fort Jackson Field; 7 miles of 8-in. laterals in Manila Village Field.
Status: Plan to apply for FPC permit.
Completion: December 1, 1957.

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Pipeline Patrol

Spokane Natural Gas Co.
Project: 400 miles of 1 through 24-in. distribution system at Spokane.
Status: Under way.
Contractor: **Hallmac Construction Co.; V. L. Williams**, spread superintendent, office at Spokane.
Completion: 1957.

- **Tennessee Gas Transmission Co.**

Project: 221 miles of 30-in., 101 miles of 26-in., and 10 miles of 24-in. looping from Portland, Tenn., to Greenup, Ky.; from Morehead, Ky., to Catlettsburg, Ky.; from Catlettsburg to Broad Run, W. Va.; from New Wilmington, Pa., to Mercer, Pa.; and from New Castle, Pa., to near Pittsburgh, Pa.
Status: Pending FPC approval.
Project: 51 miles of 26-in., 51 miles of 20-in., and 17 miles of 12-in. gathering lines from Kinder, La., to offshore fields in Gulf of Mexico.
Status: Pending FPC approval.
Project: 577 miles of 30-in. from Mississippi River delta area south of New Orleans to Portland, Tenn.
Status: Pending FPC approval.
Project: 76 miles of 24-in. between Coudersport, Pa., and Hamburg, N. Y.
Status: Pending FPC approval.

- **Texas Eastern Transmission Co.**

Project: 422 miles of 30-in. from near McAllen to Beaumont, Tex., to move imported Mexican gas; 45 miles of 24-in. laterals from McAllen to Provident City, Tex., 77 miles of 30-in. looping between Kosciusko, Miss., and Uniontown, Pa.; 147 miles of supply and sales laterals.
Status: Under way.
Contractor: **Houston Contracting Co.** has 121 miles of 30-in. between Angleton and Vidor, Tex. **H. C. Price Co.** has 70 miles of 30-in. **H. B. Zachry Co.** has 201 miles of 30-in. starting near McAllen and running northeast to near Angleton, Tex. **Grayco Constructors, Inc.** has 45 miles of 24-in. laterals from Blessing to Provident City. **Western Pipe Line, Inc.**, Austin, has 30-in. crossings at Nueces, Lavaca, and Carancahua bays. **Missouri Valley Dredging Co.**, Omaha, has crossings at Hinds and Guadalupe bays. **Altgelt Construction Co., Inc.**, has 100 miles of 3, 4, 6, 8-in. gathering lines in the Corpus Christi area.
Project: 17 miles of 8-in. and 3 miles of 6-in. from its 20-in. Baytown-Hankamer line to Alco-Mag field in Harris County, Texas.
Status: Has FPC approval.
Project: 97 miles of 30-in. loops between Kosciusko, Miss., and Uniontown, Pa., and 40 miles of new lateral supply lines.
Status: Filed for FPC permit March 15, 1957.
Completion: September 1, 1957.

- **Texas Illinois Natural Gas Pipeline Co.**

Project: 10 miles of 36-in. to loop existing single 30-in. near Joliet, Ill.
Status: Has FPC approval.

- **Transcontinental Gas Pipe Line Corp.**

Project: 172 miles of 36-in., 68 miles of 30-in., 162 miles of 24-in., and 64 miles of smaller diameter pipe to loop main line from Texas to New Jersey.
Status: Work in North Carolina to start late May 1957.
Contractor: **Western Construction Co.** has 65 miles of 36-in. and 45 miles of 30-in. at scattered spots along the system in South Carolina, North Carolina, Pennsylvania, and Virginia. Western will start work in North Carolina, spread office at Winston-Salem.
Completion: Total project to be completed December 1957.

- **United Gas Pipe Line Co.**

Project: 40 miles of 8-in. from Baldwin County, Alabama, to Container Corp.'s plant.
Status: Applied to FPC.

Canadian Crude-Oil Pipelines

- **B-A Alberta Pipe Line, Ltd.**

Project: 35 miles of 8-in. to connect Drumheller field, Alberta, with existing lines running to Edmonton.
Status: Pending approval.

Interprovincial Pipe Line Co.
Project: 156 miles of 20-in. to extend present line from Sarnia to Port Credit, Ont.
Status: To start May 1957.
Contractor: **Somerville Construction Co.** has 90 miles; **Majestic Contractors, Ltd.**, has 66 miles.
Completion: September 1, 1957.
Project: 33 miles of 24-in. from Kendal to Peebles, Sask.
Status: To start June 1, 1957.
Contractor: **Fulton-Banister, Ltd.**
Completion: July 31, 1957.
Project: 79 miles of 26-in. from Clearbrook, Minn., to Superior, Wis.
Status: To start June 1, 1957.
Contractor: **R. H. Fulton & Co.**
Completion: August 31, 1957.

Pembina Pipe Line, Ltd.
Project: 100 miles of 3 to 12-in. gathering line in Pembina oil field.
Contractor: **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., T. Childress, spread superintendent, office at Drayton Valley, Alta.
Completion: November 1, 1957.
Project: 32 miles of 16-in. from Calmar to Edmonton, Alta.
Status: Work starts April 15, 1957.
Contractor: **Universal Pipe Lines, Ltd.**, subsidiary of Mannix, Ltd., Otis Hare, spread superintendent, office at Calgary, Alta.
Completion: July 1, 1957.

Rangeland Pipe Line Co.
Project: 48 miles of 12-in. between Sundre and the Sylvan Lake in south-central Alberta.
Status: Under way.
Contractor: **Dutton-Williams Brothers, Ltd.**
Completion: August 1957.

- **Royalite Oil Co., Ltd.**

Project: 250 miles of line to move oil from the Athabasca oil sands of northeastern Alberta to Edmonton.
Status: Long range plans.
Completion: 1960.

- **Trans Mountain Oil Pipe Line Co.**

Project: 100 miles of 30-in. loops: 50 miles east of Kamloops, B. C., and 50 miles west of Edson, Alta.
Status: Under way.
Contractor: **Marine Pipeline & Dredging, Ltd.**, has Thompson River crossing, B. C., J. H. McCartney, spread superintendent, office at Kamloops, B. C. **R. A. Conyes Construction Co.** has the 50 miles east of Kamloops; **Dutton-Williams Brothers, Ltd.** has the other 50 miles.
Completion: River crossing will be done by June 15, 1957; remainder by July 31, 1957.

- **Westspur Pipe Line Co.**

Project: 20 miles of 12-in. from Alida in southeastern Saskatchewan, to the Carnduff-Glen Ewen area to tap Cantal, Hastings, Florence, Carnduff, and Glen-Ewen fields; 34 miles of 4, 6, 8-in. gathering lines.
Status: Planned. Has requested permit from Board of Transport Commissioners.
Project: 75 miles of 16-in. from Steelman, Sask., to Cramer, Man., Canada.
Status: Work starts May 1957.
Completion: July 30, 1957.

Canadian Products Pipelines

Hydrocarbons Pipeline Co. (Subsidiary of Canadian Hydrocarbons)
Project: 800 miles of 6 and 8-in. L.P.G. line from near Edmonton, Alta., to Fort William, Ont.
Status: Has permit from Parliament of Canada. If approved by Federal Board of Transport Commissioners and the Alberta Petroleum and Natural Gas Conservation Board, work will start early 1957.

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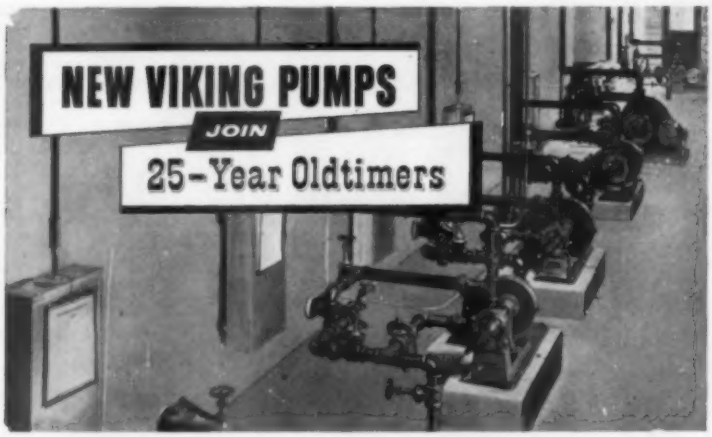

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Pipeline Patrol

Construction consultants: **Dutton-Williams Brothers, Ltd.**, Calgary, and **A. D. Little & Co.**, Boston.

Imperial Oil, Ltd.

Project: 37 miles of 12-in. from Waterdown to North Toronto, Ont.

Status: Under way.

Contractor: **Majestic Contractors, Ltd.**, Otis Hare, spread superintendent, office at Cooksville, Ont.

Canadian Gas Pipelines

• **Alberta Gas Trunk Line Co., Ltd.**

Project: 637 miles of 34 to 16-in. gathering lines in Alberta.

Contractor: **Dutton-Williams Brothers, Ltd.**, has preliminary studies, design and management-engineering. **Universal Pipe Line, Ltd.**, subsidiary of Mannix, Ltd., jointly with **Marine Pipeline & Dredging Co.**, has crossing of Red Deer River near Cavendish, Alta., J. Hysuick, spread superintendent, office at Empress.

Status: River crossing completed. Total project to be completed in 1960.

Inland Natural Gas Co., Ltd.

Project: 304 miles of mainline and 25 miles of laterals from Savona to Nelson, B. C.: 150 miles of 12-in.; 112 miles of 10-in.; 67 miles of 6-in. Also will build 400 miles of distribution piping in 31 towns.

Status: Under way.

Contractor: **Dutton-Williams Brothers, Ltd.**; Pat Campbell, project manager, office at Penticton.

Completion: October 1, 1957.

Saskatchewan Power Corp.

Project: 13 miles of 4-in. lateral to town of Kerrobert, and 10 miles of 6-in. lateral to Kindersley Power Plant, Sask.

Status: Planned.

Contractor: **Banister Construction, Ltd.**

Completion: July 15, 1957.

Project: 300 miles of 1 to 20-in. distribution lines at Regina, Sask.

Status: Planned.

Contractor: **S. E. Construction (Alberta), Ltd.**, and **Pacific Pipeline Construction Alberta), Ltd.**, jointly.

• **Trans-Canada Pipe Lines, Ltd.**

Project: 574 miles of 34-in. from the Alberta-Saskatchewan border to Winnipeg. (First part of 2,250-mile line from Alberta to Toronto and Montreal.)

Status: Under way.

Contractors: **Majestic Contractors, Ltd.** (104 miles from Burstall to Stewart Valley, Sask., R. L. Leaonard, spread supt., office at Cabri.; **Canadian Bechtel, Ltd.** (110 miles from Swift Current to Moose Jaw, Sask., J. L. Work, general supt., office at Moose Jaw, and 54 miles from Portage la Prairie to Winnipeg); **Universal Pipe Line, Ltd.**, subsidiary of **Mannix, Ltd.**, (90 miles from Moose Jaw to Welseley, spread superintendent, Otis Hare, office at Regina, Saskatchewan); **Dutton-Williams Brothers, Ltd.** (97 miles from Deveren to Moosomin, under way, to complete August 1957). **Price-Poole of Canada, Ltd.**, has 100 miles from Miniota to near McGregor to start in 1957. **Marine Pipeline & Dredging, Ltd.** has 30-in. Red River and Assiniboine crossing in Manitoba.

Completion: Red River crossing to be completed May 31. Assiniboine River crossing completed.

• **Union Gas Co. of Canada, Ltd.**

Project: 142 miles of 26-in. from Dawn Township to Hamilton, Ontario, plus 55 miles of 6 to 20-in. laterals, and 317 miles of 2 to 12-in. distribution lines.

Status: Planned.

Completion: November 30, 1957.

Project: 17 miles of 8 to 20-in. storage lines in Dawn Township, Ontario.

Pipeline Patrol

Status: Planned.
Completion: August 1957.

• **Westcoast Transmission Co., Ltd.**
Project: 650 miles of 30-in. from Peace River area, Canada, to Sumas, Wash.
Status: Under way. About two-thirds completed.
Contractors: **Dutton-Williams Brothers Ltd.,** has 120 miles from Taylor, B. C., to Azouzetta Lake, completed; **Universal Pipe Lines, Ltd.,** subsidiary of **Mannix, Ltd.,** has 110 miles between Huntingdon and Kingsvalle, B. C., F. L. Byers, spread superintendent, office at Hops, B. C.; **Canadian Bechtel, Ltd.,** has 210 miles from Alexandria to Pine Pass, B. C., H. F. (Hank) Mogg, spread man, office at Quesnel, B. C.; **R. A. Conyes Construction Co.,** has 210 miles; **River Construction Corp., Ltd.,** has under way 150 miles of gathering lines in northern Alberta and British Columbia; **Marine Pipeline & Dredging, Ltd.,** has Fraser and Peace River crossings, Waldo Trim, spread superintendent, offices at Fort Saint John and Hope, B. C.
Completion: Dutton-Williams section completed. R. A. Conyes section and Canadian Bechtel section to be completed September 1957. Marine Pipeline work to be completed June 30, 1957. Universal Pipe Lines, Ltd. will complete work September 1, 1957.
Project: 174 miles of 30-in. from Savanna Creek area to the Canadian-Idaho border.
Status: Proposed.

Foreign Cr de-Oil Pipelines

Bolivian Gulf Oil Corp.
Project: 160 miles of 10-in. and 43 miles of 8-in. from Sicascia to Arica on the Chilean coast.
Status: Awaiting pipe.
Contractor: **Williams Brothers Co.**
Completion: December 1957.

Cia. Shell de Venezuela
Project: 23 miles of 20-in., 5 miles of 16-in., 2 miles of 24-in. from Lake Maracaibo wells to Cabimas, Venezuela.
Status: Under way.
Contractor: **Brown & Root, Inc.**
Completion: April 1957.

• **Colombian Petroleum Co.**
Project: 42 miles of 6-in. from Tibu field to Rio de Oro in Colombia.
Status: Planned.

• **Creole Petroleum Corp.**
Project: 87 miles of 30-in. from Temblador field to Caripito in Venezuela.
Status: Planned.
Completion: 1959.
Project: 9 miles of 26-in. from Ule to La Salina in Venezuela.
Status: Planned.
Completion: Late 1957.

• **Iraq Petroleum Co.**
Project: About 600 miles of up to 40-in. from Kirkuk field through Iraq and Turkey to the Turkish port of Iskenderun on the Mediterranean sea.
Status: Proposed. Survey completed.

• **Mene Grande Oil Co.**
Project: 59 miles of 30-in. from fields in Eastern Venezuela to Puerto La Cruz.
Status: To start in 1957.
Completion: First quarter 1958.

• **North-West Oil Pipelines Co.** (newly formed by six West German refiners, headed by affiliates of Standard Oil Co. (N.J.), and British Petroleum Co., Ltd.)
Project: 210-mile line from the refining centers in the industrial Ruhr area of West Germany to Wilhelmshaven.
Status: Planned.
Completion: 1959.

• **Royal Dutch-Shell**
Project: 700-mile line across Europe from the Mediterranean to the North Sea, running through Eastern France, Luxembourg, West Germany, and Netherlands, and Belgium. Main trunk to be 30-in.
Status: Company is considering project together with several other companies.

Sinclair Oil Corp. and Socony Mobil Oil Co. Co.
Project: 211 miles of 20-in. from the Silvestre field in Barinas, Venezuela, to Puerto Cabello on Caribbean Sea.
Status: Under way.
Contractor: **Williams Brothers Sudamericano, Ltd.**
Completion: July 1957.

• **Ste. Nationale de Recherche et d'Exploitation des Petroles en Algerie**
Project: Line in Sahara Desert area to move oil from Hassi Massaoud field. Two routes possible: 200 miles from the field northwest to Laghouat; 260 miles from the field to the north and slightly east to Biskra.
Status: Under study.

Union of Soviet Socialist Republic
Project: 2,300-mile Trans-Siberian crude and products line from Ufa and the Tuimaza fields in Bashkiria to Irkutsk near Lake Baikal.
Status: Under way.

Yacimientos Petroliferos Fiscales (Argentina)
Project: 932 miles of 12-in. from Campo Duran to San Lorenzo.
Status: Under way.
Contractor: **TECHINT** (Compania Tecnica Internacional), Buenos Aires, has 90 miles.
Project: 497 miles from Mendoza to Buenos Aires.
Status: Proposed.

Foreign Products Pipelines

Israeli Government
Project: A 6-in. line from the Haifa refinery to Tel Aviv.
Completion: Late 1957.

National Iranian Oil Co.
Project: 573 miles of 10-in. from Ahwaz to Teheran, Iran.
Contractor: **Enterpose of Paris,** has northern 236 miles. Southern section completed.

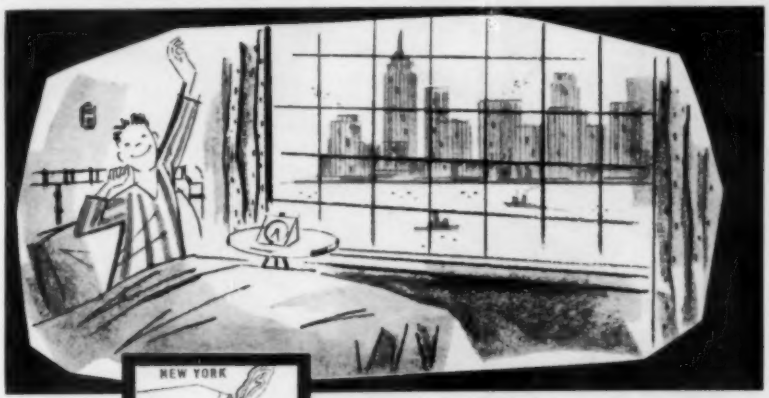
• **North Atlantic Treaty Organization (NATO)**
Project: 2,000 miles of lines to airfields in parts of Europe.
Status: Under way.
Contractors: **Associated Pipeline Contractors, Inc.,** has 450 miles from Iskenderun, Turkey, to Batman. **TECHINT** (Compagnia Tecnica Internazionale), Milano, Italy, has 205 miles of 4-in. from Bandirma to Eskisehir, Turkey, and 250 miles of 8-in. from Antalya to Eskisehir. Bids were taken in January 1956 on 300 miles of 12-in. between Marseille and Langres, France. Taking bids on 275 miles in northwestern France; 54 miles of 2-in. from Langres to Mirecourt, 63 miles of 2-in. from Mirecourt to Phalsbourg, 47 miles of 8-in. from Mirecourt to Metz, 30 miles of 8-in. from Phalsbourg to Deux Ponts, 35 miles of 8-in. from Phalsbourg to Strasbourg.

United States Defense Department
Project: Sponsoring 485 miles of 8, 10, 12-in. from Cadiz to Zaragoza, Spain.
Contractors: Prime contractor — **Brown-Raymond-Walsh; Merrit Chapman & Scott, Benson & Montin** of Oklahoma City, **Agroman Construcion Co.** of Spain.

Foreign Natural-Gas Pipelines

Andes Pipeline Corp. (Subsidiary of Glenn McCarthy, Inc.)
Project: 500 miles of 12-in. from McCarthy's Bolivian concession to the Chile copper-mining area.
Status: Proposed.

(Continued on page 279)



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Among the Drilling Contractors

Operation Big Stretch

New rig starts its upward climb . . .

. . . Gathers speed . . . Ready for business

When Carpenter-Trant Drilling Co., of Denver and Casper, took on the contract to deepen Continental Oil Co.'s Wyman Draw wildcat test 28 miles southeast of Worland, in Washakie County, Wyoming, in the Big Horn basin, it put in operation a brand new rig.

The rig, shown in the accompanying pictures while mast was being raised for this, its first job, is assembled around a Brewster N-85 draw works. This is packaged with a two-engine compound and two Twin Disc hydromatic couplings, powered by two 450-hp. Superior diesel engines (Models PTD), naturally aspirated, with one 40-in. hydromatic brake.

The wildcat, 1 Unit, in 11-46n-89w, a Tensleep test, has been deepened from its former total depth of 5,922 ft. to 6,834 ft.

Carpenter-Trant Drilling Co., organized in 1945, has been active in the Wyoming area for more than 5 years. Including the new assembly, it now is operating four rotary rigs, all in the Big Horn basin. They are under the supervision of John Anderson, field superintendent. Heading the company is William H. Carpenter, president.

Parker Drilling Co., Tulsa, will drill a 12,000-ft. test for Humble Oil & Refining Co. at a wildcat location 3 miles south of the South Saunders area, 18 miles west of Lovington, in western Lea County, southeastern New Mexico. Location is on Humble's state "AU" lease, in 4-16-33.

Crow Drilling & Production Co., Shreveport, will drill a 5,760-ft. Paluxy test a mile north of Indian Lake field, in southwestern Madison Parish, northeastern Louisiana. It is a contract job for E. J. Murdock, trustee, of Shreveport. Location is for 1 Holloway, in 12-15n-9e. It is 6½ miles northeast of Crowville, and 2½ miles southeast of Lamar field.

Southeastern Drilling Co., Dallas, has contracted for a deep wildcat test Monterey Oil Co. has scheduled for the Bayou Piquant area, in the coastal

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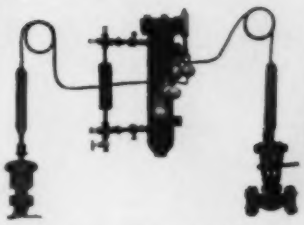

Yes, having an INFERNO Boiler Safety Unit is like having an extra employee on the job because it frees the fireman for other duties and provides a three-way safety precaution against accidents. Can't be beat for protection against explosions. Write for Bulletin 15-C for full details.

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marshes of Terrebonne Parish, Louisiana. Location, 1 Continental, in 9-18s-15e, is 2 miles northeast of Bayou Piquant production, and 4 miles west of Lake Hatch field. Permit is for 15,000 ft.

Doran Drilling Co. is drilling for Exeter Oil Co., Ltd., at a wildcat location 2 miles north of Dinero, in southeastern Live Oak County, South Texas. Location is listed as 2 Pugh, in the James McGloin Survey. Plans call for a 6,000-ft. test.

Bullard Drilling Co., Houston, has another deep contract operation scheduled for Union Oil Co. of California in the East Lake Palourde area, Assumption Parish, Louisiana Gulf Coast. It is an extension test, about ¾ mile southeast of production, at 1 Sasthene Pennison, in 32-15s-14e. Plans call for drilling to 13,500 ft.

Marshall R. Young, Fort Worth, has a new contract operation in Smith County, Mississippi. It is a 12,500-ft. wildcat test for California Co. Location is 1½ miles north of Traxler in 12-2n-6e. It is California's 1-7 Central. Objective is the Bailey (Sligo) sand found productive in California Co.'s recently completed discovery well of Raleigh field, 5½ miles southeast.

Sunnyland Contracting Co. Rayne, La., has scheduled a wildcat test to be drilled about 2½ miles west of Pollard field, in southern Escambia County, southern Alabama. Sunnyland has taken the job as a joint operation with C. Dale Armour, of Pensacola, Fla. Plans call for a test 50 ft. into the Lower Cretaceous, or 6,650 ft. The rig is coming from a 7,500-ft. test Sunnyland has just completed drilling for Sun Oil Co. northeast of Bayminette, in Baldwin County, about 25 miles southwest of the Escambia County project, located in 9-1n-8e, on Alger-Sullivan Lumber Co. land.

K. L. Kellogg & Sons., Compton, Calif., have contracted for a deep exploratory well to be drilled near the center of Guijarral Hills field, 8 miles east of Coalinga, in Fresno County, California. Operator is L. A. Harnish, who plans to go to 13,500 ft., in the Eocene. Location is for E53-34F Allison, in 34-20-16.

J. E. Woofter, Flora, Ill., is moving in a light rotary rig to a rank wildcat location in Clay County, northeastern Arkansas, where he will drill a shallow (1,370-ft.) test for Grant Gallatin, of Casey, Ill. Location, at 1 Caloway, in 17-19n-8e, is about 7½ miles southwest of Piggott.

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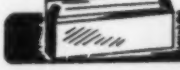

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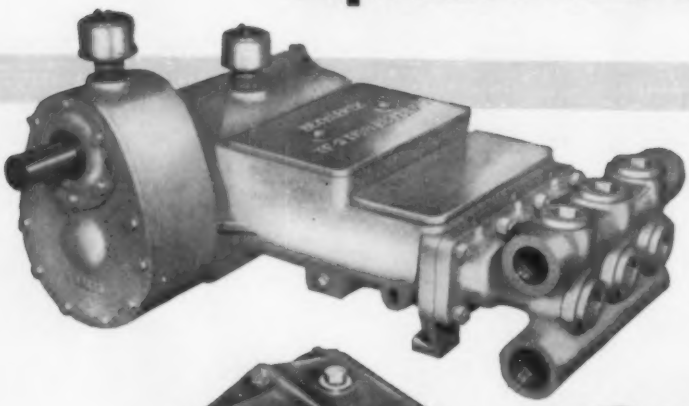
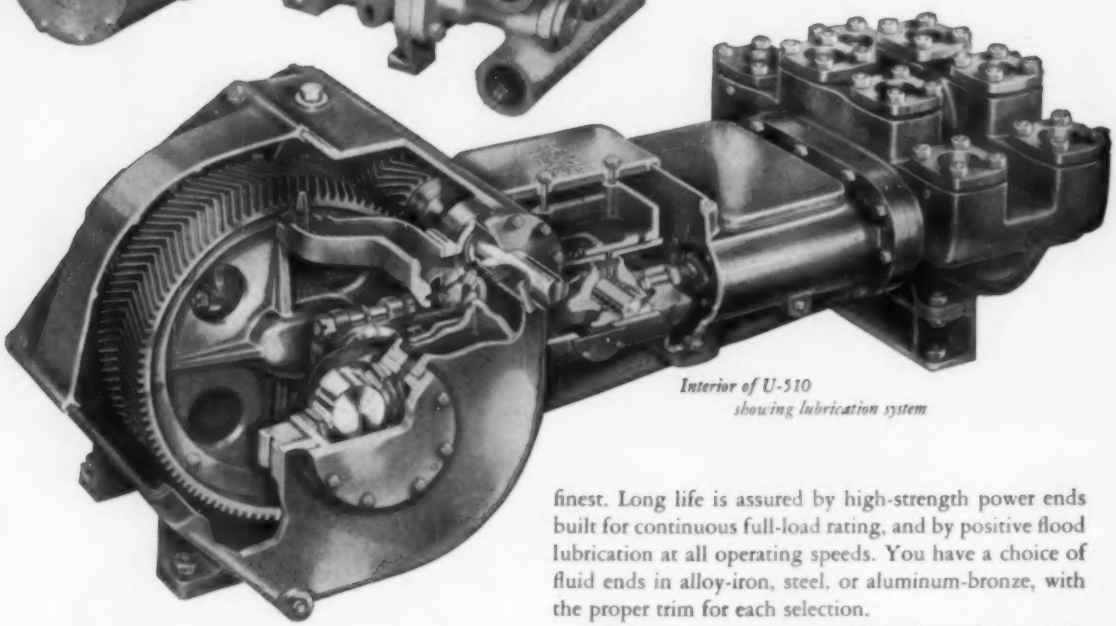


TP-3 Triplex Pump



Interior of U-510 showing lubrication system

Bethlehem now offers five distinct sizes of general-service pumps, so that it's even easier to pick just the right unit. We doubt that you've ever seen a line of pumps with so much versatility. Each is a "handy man"—a pump that can readily be adapted for several different kinds of work.

Does your job involve waterflooding? Salt-water disposal? Pumping crude oil in gathering systems or pipe-line service? Pumping mud or water for the drilling rig? If the answer is yes, there are Bethlehem units that will fit perfectly into your engineering plans.

You can bank completely on the quality of these pumps. Components are exhaustively tested. Materials are the finest. Long life is assured by high-strength power ends built for continuous full-load rating, and by positive flood lubrication at all operating speeds. You have a choice of fluid ends in alloy-iron, steel, or aluminum-bronze, with the proper trim for each selection.

Bethlehem pumps are so well engineered that their salvage value is always high. We feel certain that their many advanced features will interest you. If you will write or call, our people will gladly furnish complete information.

FIVE SIZES, DUPLEX AND TRIPLEX

Model	Type	Plunger Load, lb	Input Hp	Bore & Stroke, in.
U-33	Duplex	2400	14 @ 180 rpm	1¼ to 3 x 3
UA-46	Duplex	5000	40 @ 120 "	2½ to 4 x 6
U-510	Duplex	12000	100 @ 75 "	3 to 5½ x 10
TP-3	Triplex	3580	22.4 @ 250 "	1¼ to 2¼ x 3
TP-4	Triplex	5000	42 @ 250 "	2 to 4 x 4

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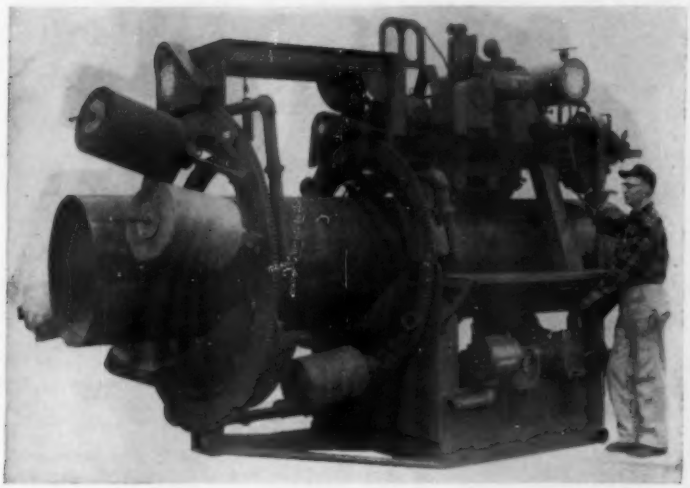
NEW EQUIPMENT



Line-Traveling Machine Double Coats

With this new Crose line-traveling machine, pipe with a diameter of up to 40 in. can be double coated and double wrapped. Flexibility is one outstanding feature of the machine. According to the maker, it will double coat and double wrap pipe with diameters ranging from 30 to 40 in.

Compact and relatively light in weight, it has a variable speed reducer to eliminate chains and sprockets, thereby making possible a quick lap change and low maintenance costs. **Write or call: M. J. Crose Mfg. Co., Inc., 2715 Dawson Road, Tulsa, Okla., for details on double-coating and double-wrapping machine for 40-in. pipe.**

●

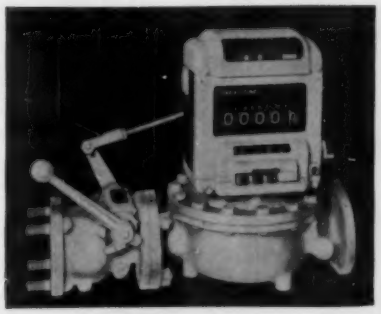
Pipeline Coater Speeds Field-Joint Coating

A fast and easy method of coating field joints is provided by this new Protecto Wrap flood coater, the maker reports. The product consists of inorganic glass fiber impregnated with a bituminous pipe coating of coal tar or asphalt base, with an asbestos-felt backing. It is wide enough to cover the total cut-back where pipe is welded together. And it's long enough to cover the circumference of the pipe, plus an additional length to provide overlap on top of the pipe.

The use of the flood coater permits an effective and economical method of applying hot enamel to field joints, according to the maker. The coater is applied by hand in the granny-wrap style. Because the coater is reinforced with woven-glass fabric, high tension can be used in application without tearing or breaking the coater.

The flood coater permits easy and efficient application of hot enamel, saves coating material, and provides a field joint which has ample thickness at the weld, is reinforced, and backfill protected, the maker states. Made for all sizes of pipe it's shipped precut to specified size. **Write or call: Protecto Wrap Co., 2255 South Delaware, Denver, Colo., for details on flood coater.**

●



Liquid Meter Repeats Batch Size

Each time the valve is opened, this new Neptune repeating Auto-Stop liquid batching meter delivers the same quantity of liquid. And it shuts off automatically when the preset quantity is reached. The quantity setting may be changed by simply pressing the Auto-Stop buttons on the register.

The meter may prove particularly

Send this **Showcase Coupon**
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Described in OIL AND GAS JOURNAL - Issue of **April 1, 1957**

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New Equipment

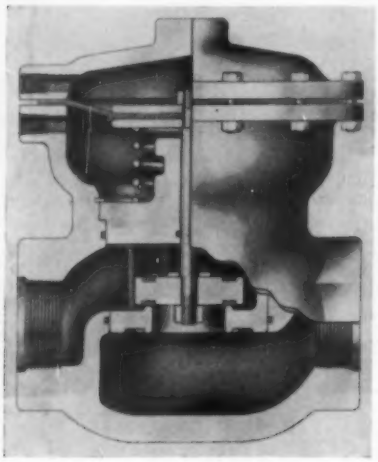
useful for production batching and blending operations where the same formula is repeated over and over again.

One valuable feature of the meter is that the chance of human error may be greatly reduced because the quantity setting is made only once, regardless of the number of times any set quantity is delivered.

In addition, the large, easy-to-read numerals provide visual confirmation of each delivery. When permanent proof is desired, a ticket-printing feature can be included.

And when a batch size or formula is changed, only a few seconds are required to press the Auto-Stop buttons and reset the register to the new quantity. **Write or call: Neptune Meter Co., 19 West Fiftieth Street, New York 20, N. Y., for details on Auto-Stop liquid batching meter.**

●



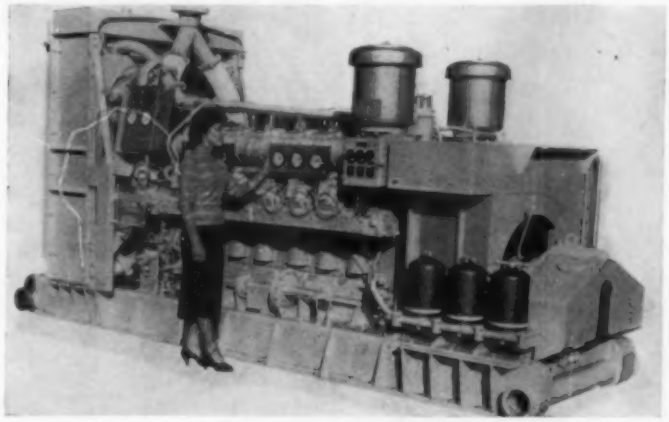
Two-Way Motor Valve May Eliminate Flow Lines

Reduced automation costs and improved automatic performance are features claimed for this new Odex-Parks two-way motor valve. The valve is available in a 2-in. size in either normally open or closed position.

It can be used with an Odex three-way valve to eliminate the need for high-pressure flow lines in automatic pump or flow installations.

On automatic installations, should the overpressure cutoff at the wellhead, which controls the flow line pressure and contains high pressure in the well, leak or fail to operate, the built-in relief feature of the valve prevents damage to flow lines, equipment, or personnel, according to the maker.

Other advantages listed for the valve include: (1) easy repair because of simplified design and few parts, all removable through the top; (2) low pressure drop across the valve because of full, open ports; and (3) elimination of high-pressure flow lines. **Write or call: Odex Engineering Co., 1410 N. Grant, Odessa, Tex., for details on two-way motor valve.**



Diesel Unit Available in Seven Sizes

On this Paxman Drilpak 400, a packaged diesel engine fitted with a fluid coupling, over 70 per cent of the component parts are interchangeable, the maker states. Made in England, the packaged unit is available in seven sizes with power outputs ranging from 128 to 800 shaft horsepower continuous at 1,200 r.p.m. Besides the fluid coupling, the unit is available with a torque converter.

Its applications include both drawworks and mud-pump drive. According to the company, full use is made of unified and A.P.I. screw and pipe threads. And plastic-dipped spare parts are available, permitting unlimited storage time.

Other features of the unit include: (1) a radiator suitable for tropical conditions, (2) an illuminated instrument panel showing water-outlet temperature, lubricating-oil temperature and pressure, and exhaust temperature, (3) inverted quick-servicing oil filters with expendable elements, (4) a torsional vibration dampener, and (5) a load indicator. **Write or call: Davey, Paxman & Co., Ltd., 1 Balfour Place, Mount Street, London, W. 1, for details on Drilpak 400.**

●

Liquid-Gas Separator Removes Liquids, Solids

Now 12 standard sizes of this Selas Liqui-Jector, a liquid-gas separation device for removal of entrained liquids and solids from air, gas, and steam systems, are available. The device completely removes suspended liquid (water, oil, and emulsion) and solid particles from process and instrument gas-supply lines.

It operates by phase separation—trapping solids and passing liquid in one direction and gas in another—without interrupting the flow through the line, the maker states.

It comes in three standard models: Series A for volumes up to 100 s.c.f. per minute of gas at 150 psig; Series B for volumes up to 7,000 s.c.f. per minute of gas at 200 psig.; and Series C for conditions where unusually large volumes of condensate are encountered. **Write or call: Selas Corp. of America, Dresher, Pa., for details on Liqui-Jector.**

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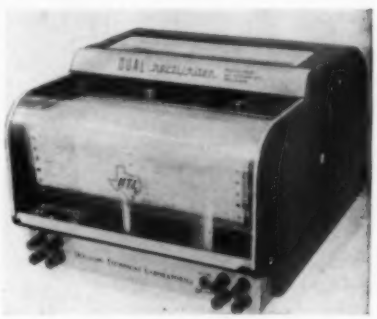

Rectilinear Recorder Monitors Functions Simultaneously

Two functions can be monitored simultaneously in their true wave forms with this new two-channel rectilinear writing galvanometric strip-chart recorder, according to the manufacturer.

The recorder uses a single chart drive

DIAMONDS GO TO SEA

Christensen's newly formed department devoted exclusively to Offshore operations can be tremendously important to you, the Offshore operator. This department provides the right diamond equipment, matched to the operator's needs, when and where required. The greater core recovery of diamond bits plus their time-saving penetration rates are more reasons why it makes good sense to consult the Christensen engineer regarding your Offshore problems.

Do you have our catalog?
Write today for SD-608.

CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH 2nd WEST SALT LAKE CITY 10, UTAH

Turn the page for a case history of diamond equipment in Offshore use.→

CHRISTENSEN DIAMOND PRODUCTS

Performance Report

No. C-350

DIAMOND CORING BIT INCREASED PENETRATION RATE BY 100%, REDUCED BIT COST PER FOOT BY 75%, GAVE 96.7% CORE RECOVERY IN STICKY, CRUMBLING SAND AND SHALE.

BIT DATA:

Description–12 waterway, spiral Design, "B" Crown
Size–7¾" x 4"
Diamonds–Large, first quality stones
Original Bit Sale Price–$4860.00
Net Bit Cost–After Salvage, $1500.12
Bit Cost per Foot–$3.24

Location:

Offshore from Morgan City, Louisiana

Formation:

Unconsolidated green shale and sands of Upper Miocene Age.

Performance:

This Christensen Diamond Coring Bit cored a total of 463 feet at 4 feet per hour and the operator recovered 448 feet of core. Other types of coring equipment were coring at 2 feet per hour, bit life averaged 12 feet, core recovery was approximately 40% and round trips were taking 7 hours each. The peculiar sticky, crumbling sand and shale, although only medium hard, presented a difficult coring problem. The formation would clog the bit, yet excessive fluid volume would wash the core. The spiral waterway design coring bit, with each waterway angled so fluid would flow across bit face, assured uniform cleaning and cooling of the diamonds. The Christensen Engineer also recommended a shim adapted to the core barrel to bring the inner tube shoe closer to the mouth of the bit, reducing to a minimum the area of core exposed to drilling fluid.

Operating Conditions:

Bit load — 6000-10,000 lbs. Rotary table speed — 40-50 RPM
Fluid volume — 170 GPM. Water depth — 60 ft. Remarks — Directional hole with 3 whipstocks set, no unusual drag encountered.

Do You Have Our Catalog?
Write for SD 608-56 Today

CHRISTENSEN DIAMOND PRODUCTS

1937 SOUTH 2nd WEST SALT LAKE CITY, UTAH

New Equipment

and records the two variables on a two-channel rectilinear chart with a common time base. It has high deflection sensitivity and is adaptable to a variety of circuits and uses galvanometer meter movements.

Design features of particular interest include: (1) a "writing desk" area for manual notations on the chart, (2) front-located zero adjust, (3) front-mounted controls and signal terminals, and (4) finger-tip 10-speed gear-shift chart drive. And event-marker pens can be mounted on each side of the chart. **Write or call: Texas Instruments, Inc., Industrial Instrumentation Div., P. O. Box 6027, Houston, Tex., for details on Dual recti/riter.**

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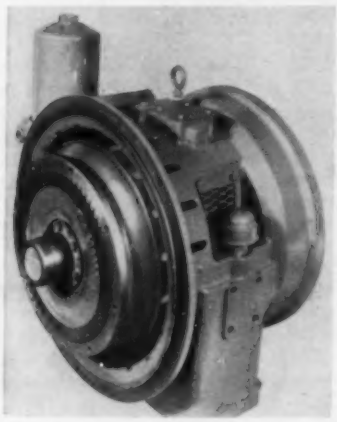

Torque Converter Handles 30 to 212-Hp. Engines

On high-speed diesel and gasoline engines, this new Series 1300 single-stage torque converter may be used to advantage. It's designed for engines producing from 30 hp. at 1,450 r.p.m. to 212 hp. at 3,200 r.p.m.

Its specific torque ratings are 165, 200, 240, 285, and 330 lb.-ft., depending on the impeller blading selected. Its maximum input torque is 350 lb.-ft.

One interesting feature of the torque converter is that it unloads the engine at high-speed ratios.

Another design feature is that impellers having different bladings (both number of blades and pitch) are interchangeable. Thus the converter can be matched as accurately as possible to engines of various horsepower outputs and speeds, within rated limits, without requiring changes in the converter or other components. **Write or call: Twin Disc Clutch Co., Hydraulic Div., Rockford, Ill., for details on Series 1300 torque converter.**

Portable Barrel Pump Meters Chemicals From Drums

With this new controlled-volume pump for barrel-head mounting, the user can meter toxic or corrosive chemicals from upright, 55-gal. barrels against pressures to 100 psi. It's available in maximum capacities from 500 ml. to 4 gal. per hour.

The portable barrel pump has a constant speed ⅓-hp. 115-volt 60-cycle motor. Its capacity is adjustable from zero to maximum. **Write or call: Milton Roy Co., 1300 East Mermaid Lane, Philadelphia 18, Pa., for details on portable barrel pump.**

Instrument Air Dryer Tells When to Change Cartridge

In instrument lines, this new desiccant type of dehydrator may prove useful. Called the King instrument air dryer, the unit is designed to remove water vapor from compressed gases serving liquid-level gages, air valves, and other pneumatic equipment on dead-end or low-flow service in remote locations.

Providing a dew point of —60° F. or lower, it can be used at 100 psig. It has a capacity of 60 s.c.f per hour at 70° F., the maker states.

The case and head are of brass and bronze. And the cartridges are plastic-coated aluminum, filled with Sovabead desiccant. **Write or call: King Engineering Corp., Box 645, Ann Arbor, Mich., for Catalog 3150.**

DESIGNED, TESTED AND PROVEN IN THE OIL FIELDS

Unexcelled . . . for Outdoor Use

- DRIP PROOF
- VERMIN PROOF
- MOISTURE PROOF
- CORROSION RESISTANT
- FORCED AIR COOLED

All these features of Fieldmaster Ball Bearing Motors have been designed to overcome the rugged conditions of Oil Field requirements.

CHECK THESE OUTSTANDING ADVANTAGES.

Heavy Cast base for alignment, stability, heavy duty, double-shielded, prelubricated bearings, reduces lubrication worries, high grade silicon steel in the magnetic circuit reduces iron losses . . . Wide variety of windings provides triple ratings, dual voltages . . . high torque licks heavy starting problems. High slip is available to take care of reciprocating load requirements encountered in pumping.

FIELDMASTER

Write For Descriptive Literature.

BETHLEHEM SUPPLY CO. TULSA, OKLAHOMA

Manufactured by VALLEY ELECTRIC CORPORATION, St. Louis, 8, Mo.

SHOWCASE . . .

New Literature

Corrugated Aluminum Jacketing for insulated lines described in this new bulletin requires no special training or tools for application. And it provides protection for insulated lines, tanks, vessels, and towers in refineries and other process plants. The bulletin furnishes application methods and specifications of the jacketing and complete ordering information. The jacketing comes in individually packaged rolls, with or without a moisture barrier, in thicknesses of 0.006, 0.016, and 0.020 in. **Write or call: Aseeco, Inc., P. O. Box 6067, Houston 6, Tex., for bulletin on aluminum jacketing.**

●

Industrial Engine rated at 92 b.hp. at 3,200 r.p.m. is described and diagramed in this new two-page specification sheet. It gives power curves, design details, engineering features, and installation drawings for the new high-torque, Jeep-6 heavy-duty engine. **Write or call: Willys Motors, Inc., Toledo, Ohio, for data sheet on Jeep-6 industrial engine.**

FROM STEAM-BATH WET
TO DESERT DRY
WITH
FLORITE

Most economical of the granular drying agents, Florite has a longer service life, gives a low dew point depression, and aggressively resists "poisoning effects" which permanently destroy adsorption qualities.

Natural gas, propane, butane, gasoline, air, nitrogen, carbon dioxide, refrigeration compounds—and a growing list of liquid and gaseous compounds—are successfully treated with superior drying efficiency by use of FLORITE DESICCANT.

We also have available Fullers Earth and bauxite-based adsorbents for all types of adsorption filtration, including economical decolorization, dehydration and purification.

FLORIDIN COMPANY
Adsorbents
Desiccants
Diluents
Dept. C P.O. Box 989, Tallahasee, Florida

Liquid Filter Bulletin (16 pages) gives data on Air-Maze all-metal liquid filters with capacities of 1.7 to 720 g.p.m. for flow filtration of lubricating, hydraulic, or fuel oils. The filters are of metal-screen-disk construction with precisely controlled openings to assure positive filtration for selected degree of separation. They include types for high or low-pressure systems with or without a built-in relief valve. The bulletin furnishes data on flow rates, pressure drop, inlet and outlet sizes, weight, over-all dimensions, and required clearance for cartridge removal for a wide range of filter models. **Write or call: Air-Maze Corp., 25000 Miles Road, Cleveland 38, Ohio, for bulletin on liquid filters.**

●

Tubing for Corrosive and High Temperature Service is described in Technical Data Letters 285 and 286. These sheets offer up-to-date data on Croloy 27-4-1 Type 329 seamless stainless-steel tubing in tubular form, and Croloy 25-12 Type 3098 austenitic steel. Tables give the chemical analysis, mechanical properties, and corrosion resistance of the tubing. **Write or call: Babcock & Wilcox Co., Tubular Products Div., Beaver Falls, Pa., for ASL 285 and 286.**

●

Rotary Positive Air and Vacuum Pumps, gas boosters, and air motors are the subject of new 16-page Catalog 1957. It gives details of construction, dimensions, capacities, performance curves, and installations data. The catalog includes data on two and four-wing types; fan-cooled, water-cooled, and radiator air-cooled models; motor-driven units; direct-coupled and belt-driven models; integral pump and motor units; and automatically controlled tank units; and a line of accessories. **Write or call: Leiman Bros., Inc., 102 Christies Street, Newark 5, N. J., for Catalog 1957.**

●

Boiler Tube-Expander Control Bulletin 56-1 describes the Model C Torq-Air-Matic air-powered boiler-tube-expander drive and control. The bulletin discusses the advantages of precise tube rolling and explains the features of the new device. **Write or call: Thomas C. Wilson, Inc., 21-11 Forty-fourth Avenue, Long Island City, New York, for Bulletin 56-1.**

●

Specialized Coatings for painting damp walls and ceilings or priming rusted, damp, or unpainted metal are described in this new four-page folder. It also

The welcome mat is always out at your **UNITED SUPPLY** store

Any time, day or night, your UNITED SUPPLY store folks will welcome your call or visit. And no drilling rig or producing lease is out of reach of FAST UNITED delivery. So use the UNITED SUPPLY welcome mat . . . get the dependable parts, service or equipment you need, when you need them . . . contact the courteous people at your nearest UNITED store, 22 locations in 5 states . . . they're your supply friends.

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AND *Manufacturing* COMPANY

TULSA, OKLAHOMA

Stores in: KANSAS, OKLAHOMA, TEXAS, LOUISIANA, AND NEW MEXICO

COURTESY • SERVICE • DEPENDABILITY

covers a brushable compound that provides skid resistance on stairs, ramps, and floors. **Write or call: Wilbur & Williams Co., 130 Lincoln Street, Brighton 35, Mass., for folder on coatings.**

●

Air Compressors. This 20-page catalog covers a line of ⅓ to 20-hp. air compressors. Well illustrated, the catalog gives complete specifications on single and two-stage models, portable models, tanks, pumps, and accessories. It includes useful charts, data, and infomation on compressed air. **Write or call: Kellogg Div., American Brake Shoe Co., Rochester 9, N. Y., for bulletin on air compressors.**

●

Metallizing Powder. Two-page 8½ by 11-in. illustrated two-color Engineering Data Sheet 53 discusses the use of Colmonoy C-250 metallizing powder for reclaiming worn engines and compressor crankshafts. The new data sheet discusses the properties and characteristics of the powder and illustrates the essential steps in crankshaft preparation and application of the material. It also includes a detailed 11-step application procedure recommended by the manufacturer. **Write or call: Wall Colmonoy Corp., 19345 John R. Street, Detroit 3, Mich., for Data Sheet 53.**

●

Valve Lubricant Bulletin V-220, Rev. 1 features four new lubricants for hydrocarbon-liquid and gas services, strong acids and alkalies, alcohols, glycerine and glycols, amines, aqueous solutions, hot water and hot asphalt, natural-gas transmission-line services, and hydrocarbon and aromatic-solvent services. The bulletin contains a useful lubricant-selection chart along with instructions for lubricating and servicing plug valves. **Write or call: Meter and Valve Div., Rockwell Mfg. Co., 400 North Lexington Avenue, Pittsburgh 8, Pa., for Bulletin V-220, Rev. 1.**

●

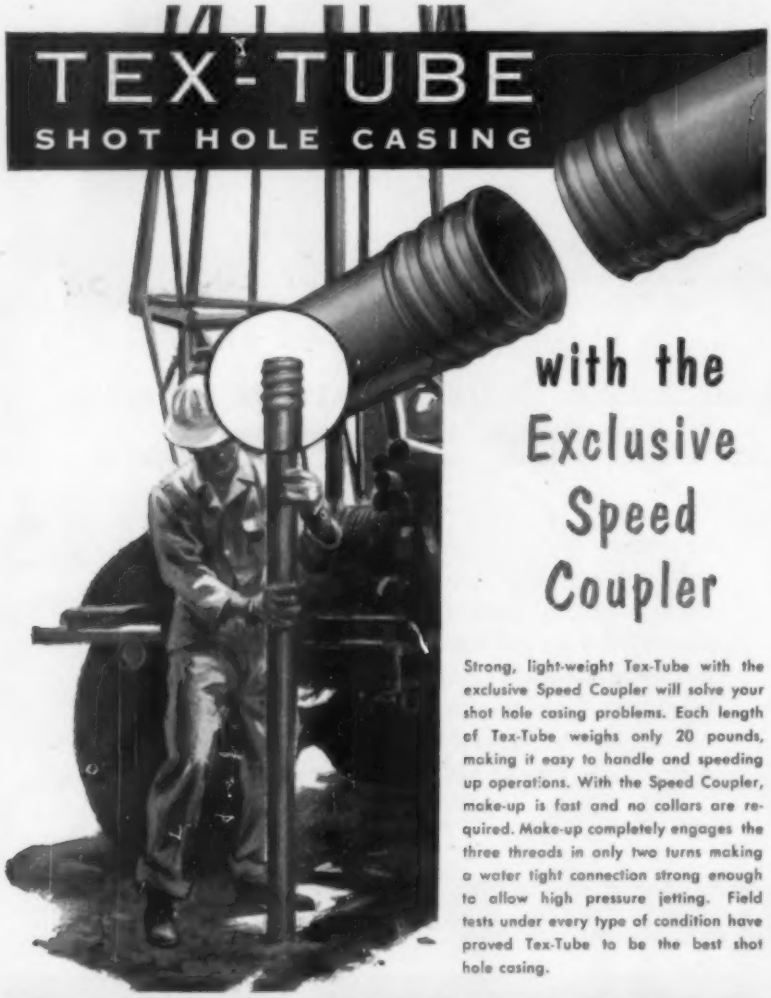
Floodlighting Catalog. Forty-eight page Catalog 156 covers cast-aluminum vaportight pendants, ceiling and wall fixtures, wiring troughs, splice boxes, other outdoor fittings, and sealed-beam floodlighting lampholders. The catalog furnishes complete lighting performance tables for long-throw 500-watt power-beam projector lamps in narrow spot, medium, and wide flood. **Write or call: Stonco Electric Products Co., 333 Monroe Avenue, Kenilworth, N. J., for Catalog 156.**

●

Impervious Graphite Cascade Coolers for cooling large volumes of corrosives such as HCl prior to product storage and for removing heat of solution during sulfuric acid dilution and similar applications are the subject of this new eight-page catalog. It illustrates the equipment with diagrams, photographs, and break-away drawings. The catalog also includes pressure-drop calculations for each model of cooler. In addition, the catalog devotes a section to a step by step guide to aid in the selection of the correct model and size of cooler for a given application. **Write or call: Falls Industries, Inc., Aurora Road, Solon, Ohio, for Bulletin 537.**

●

Flareless Tube Fittings. Comprising 28 pages, Catalog 4320 covers ⅛ to 2-in. flareless type tube fittings. The catalog includes a section on fittings for mounting in new S.A.E. straight-thread boss utilizing an O-ring for sealing. It also gives helpful assembly hints for making nonflared tube connections and methods of lubricating them along with suggestions for installing connectors. **Write or call: Tube & Hose Fittings Div., Parker Appliance Co., 17325 Euclid Avenue, Cleveland 12, Ohio, for Catalog 4320.**



with the Exclusive Speed Coupler

Strong, light-weight Tex-Tube with the exclusive Speed Coupler will solve your shot hole casing problems. Each length of Tex-Tube weighs only 20 pounds, making it easy to handle and speeding up operations. With the Speed Coupler, make-up is fast and no collars are required. Make-up completely engages the three threads in only two turns making a water tight connection strong enough to allow high pressure jetting. Field tests under every type of condition have proved Tex-Tube to be the best shot hole casing.

Tex-Tube, Inc.
P. O. BOX 7705
UNDERWOOD 9-3411
HOUSTON, TEXAS

Bakersfield, Calif.	(Par-Tain Exploration Co.)	5-3764
Baton Rouge, La.		5-1430
Corpus Christi, Tex.		TUlip 2-8141
Houma, La.		2-0569
Lafayette, La.	(Bilderback Dynamite Co.)	CEnter 4-6184
	(Gulf Coast Explosive Co.)	CEnter 4-3876
Brookhaven, Miss.	(Bilderback Dynamite Co.)	2732
Mills, Wyo.	(Teton Tool Co.)	CAsper 2-8181
Oklahoma City, Okla.	(Dupree Dist. Co.)	JAckson 8-6740
Oklahoma City, Okla.	(Grove Hardware Co.)	JAckson 8-4886

EQUIPMENT MEN . . . in the News

Larkin of Butler Appoints Barnhart to District Sales

The transfer of Ted J. Barnhart to Olney, Ill., has been announced by Larkin of Butler, Butler, Pa. Barnhart will serve as district sales representative covering Illinois, Indiana, and Kentucky from the Larkin of Butler district office and warehouse in Olney.

Barnhart joined the company's sales organization in 1954 and was moved to the Tulsa office in 1955.

Penberthy Manufacturing Names General Sales Mgr.

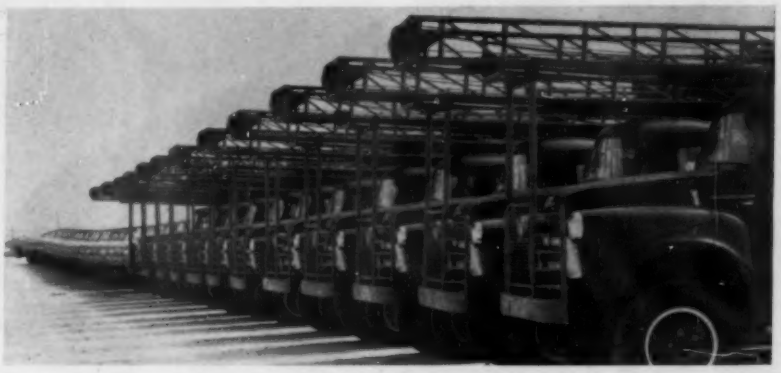
Howard E. Strohmaier brings to his new position as general sales manager of Penberthy Manufacturing Co. the selling experience gained in 20 years of service with the company. In addition to his sales experience, Strohmaier has a thorough knowledge of the firm's products as well as all other phases of its operations.

Jack, Bizzell Named Totco Field Representatives

The appointment of Howard W. Jack and Clifton O. Bizzell as field representatives for Totco's expanded service in the Texas-Oklahoma area has been announced by E. G. McConnell, vice president of Technical Oil Tool Corp.

Jack will serve a new Totco territory in the Texas Panhandle and Oklahoma. He will be headquartered at Pampa, Tex., and will report to Oklahoma-Kansas division manager, R. W. (Bo) Ard. Jack has supply-company sales experience and has previously worked for an oil-field tank company.

Bizzell will headquarter in Hobbs, N. M., working in the West Texas area under the supervision of Rudy Harralson in Hobbs and the West Texas division manager, H. I. Weathersby. Bizzell replaces Ivan Chiles who has been transferred to Laurel, Miss.



Exploration Equipment Ships Large Order to S. A.

These 42 mobile geophysical units represent the second and last part of 71-unit shipment made recently by Exploration Equipment Co. to South America. The entire shipment consisted of 25 drilling units, 34 water trucks, 5 shooting trucks, 5 cable units, and 2 instrument trucks. First loading at Port Houston involved 29 trucks.

Exploration Equipment Co. specializes in supplying the needs of foreign exploration projects. In addition to supplying standard items, the company custom-builds equipment.

Ziegler Appointed Manager Of Safety by Halliburton

H. B. ZIEGLER

Halliburton Oil Well Cementing Co.'s new manager of safety is Harry B. Ziegler. He succeeds Irby B. Cate, 33-year Halliburton veteran who retired recently. J. I. Jordan, formerly a safety director for field operations, has been named to the new position of assistant manager. Both Ziegler and Jordan are based at Halliburton's Duncan, Okla., headquarters.

Ziegler was a driller in southern Oklahoma when he joined Halliburton in 1926. Field assignments in Texas, Oklahoma, Louisiana, Illinois, and Kansas as a tester, fieldman, credit manager and assistant division manager were held by him until 1946 when he was transferred to Duncan. Since then he has helped operate Halliburton's safety department and until his promotion was a safety director for field operations.

As manager of safety, Ziegler directs four safety supervisors at Houston and Midland, Tex.; Casper, Wyo.; and Duncan, and the Duncan shops safety operations, including the shops safety director, first aid supervisor and assistant, and an industrial nurse.

Jordan joined a Halliburton predecessor company in 1934 and worked as

Brown Oil Tools Occupies New Office, Plant Facility

A complete new manufacturing plant of more than 60,000 sq. ft., designed for both mass production and custom manufacturing of petroleum production and fishing-tool equipment has been placed in operation by Brown Oil Tools, Inc. The plant is situated on a 65-acre tract in Houston. Manufacturing facilities at the old plant will be used to turn out custom jobs.

The new plant consists of an office structure, a service division building for servicing and producing fishing tools, a shop for the manufacture of packers and other production equipment. A 26,000-sq. ft. warehouse is to be started soon.

Members of the executive staff include Joe R. Brown and Ray L. Brown, sons of C. C. Brown, founder and head of Brown Oil Tools. Carl Riesel is general manager; John R. Feeser, sales manager; and L. Baker Richardson, service manager.

driver, cementer, tester, fieldman, and district supervisor until 1951 when he transferred to the Duncan safety department from Houston. During 1956 he was on special assignment for the company's personnel relations department helping develop a new field training program.

Hammond Appoints Myers Western Division Manager

FRED J. MYERS

The appointment of Fred J. Myers as general manager of the western division, with headquarters at the Provo, Utah, offices, has been announced by Ralph E. (Pat) Kramer, executive vice president of Hammond Iron Works.

Hammond Iron Works has plants at Warren and Bristol, Pa.; Birmingham, Ala.; Provo, Utah; and Casper, Wyo.

Myers spent the last few years as Warren, Pa., district sales manager. Prior to his association with Hammond, he was with Lukens Steel Co. and before that witn Welding Engineers, Inc.

Hycalog Transfers District Managers Clark and Ware

Glenn Clark has been appointed Gulf Coast district manager by Hycalog, Inc., Shreveport well-logging and diamond-bit manufacturing firm. H. K. (Bo) Ware, formerly district manager of the Arkansas-Louisiana-Texas area, has been transferred to Jackson, Miss., to replace Clark as district manager of the southeastern states.

Both men have been with Hycalog since shortly after its establishment in 1945. Clark joined the company in 1946 and Ware in 1948. Both served as logging engineers in field units for a number of years before assuming duties as district managers.

George E. Failing Holds Sales Meeting at Enid Plant

Company executives, department heads, salesmen, and field engineers attended the annual sales meeting of George E. Failing Co. of Enid, Okla., a subsidiary of Westinghouse Air Brake Co. Attending the meeting were: (front row) Walt Buller, sales manager; E. R. Lundberg, export representative, New York; Dick Miles, Houston branch manager; A. G. Floyd, Midland branch manager; John McMahan, Hattiesburg branch manager; Jack Felton, Jimmy Helton, manager of Candian operations; Robert M. Greer, president; Olaf Lindquist, European representative; E. L. Alexander, senior vice president; E. L. Martin, Casper branch manager. Arthur Johnrow, vice president, sales.

Center row: Kenneth Scheurmann, Oliver Kucera, Charles Wilson, Max Cumpston, Herschel Bules, Clarence Wheeler, Willard Britton, Bill Freeman, Ed Herbst, Clyde Baker, Burt Pedigo, Harold Holden, Russell Cowherd, Claude Chambers, H. J. Godschalk.

Back row: Harold Allen, Calvin Cook, Bill Hall, Paul Nagle, Bill Ball, Bill Hiddleston, Joe Tracy, Everett Carley, Wesley Page, Carl Collins, Julian Stetnish, V. C. Mickle, Leon Christensen.

Duve, Smith, Rench Named Napko Vice Presidents

Three veteran Napko Corp. department heads, Walter H. Duve, Sidney V. Smith, and Joseph E. Rench, have been appointed vice presidents, Ed D. Konken, president, has announced.

Duve, production superintendent for the paint-manufacturing firm, now is vice president in charge of production. He has been with Napko 30 years. He has served in almost every phase of the company's operation from paint formulator to construction engineer.

Smith is new vice president in charge of trade sales, retail stores and merchandising. He has been with Napko 6 years. He started as a sales engineer and has already been serving the company in a sales management role.

Rench, newly appointed vice president in charge of industrial sales, research and product development, has won recognition for his research ability and knowledge of coating problems, Konken stated. He was formerly technical director of Napko.

Anco Manufacturing Holds Annual Sales Meeting

Anco Manufacturing & Supply Co., affiliated with Flint Steel Corp., recently held its annual sales meeting in its home sales office in Tulsa. Company officials and Anco representatives from Memphis, East St. Louis, Des Moines, and Tulsa attended.

The meeting was held to discuss the current steel situation, the market outlook for 1957, and to view Anco's new LPG and anhydrous ammonia equipment.

Shaffer Tool Works Will Build New Gulf Coast Shop

Donald U. Shaffer, president of Shaffer Tool Works, Brea, Calif., has announced that the company will start immediate construction of an office and warehouse building in Houma, La. Completion is expected about the end of April 1957.

The new shop installation at Houma will supplement existing facilities to serve the oil and gas industry for sales and service of Shaffer oil tools in

Dowell engineers use specialized equipment to perform high-injection-rate fracturing treatments on oil and gas wells.

RIVERFRAC

it could be the best treatment for your well

To an increasing extent, Riverfrac* is proving to be a most profitable well stimulating treatment. More and more operators report that Riverfrac has given greater production increases and a slower decline than oil-base or acid-base well treatments.

Riverfrac uses unthickened water as a fracturing fluid. Its low cost, low viscosity, and salt-dissolving qualities make water an exceptionally efficient medium for many formations. In some formations, successful treatments have been made without the use of sand as a propping agent.

Dowell additives can be used to extend the successful application of Riverfrac to many zones previously considered incompatible with water.

Dowell was a pioneer in the development of Riverfrac and has an unexcelled fund of experience with this service. An experienced Dowell engineer will tailor a treatment to the requirements of your well. Why not consider Riverfrac for your next job?

If your well is a good prospect for Riverfrac, your Dowell representative can tell you. If it isn't, he will recommend the particular Dowell treatment that should be used.

For service, or more information, contact any one of the 165 Dowell offices in the United States and Canada; in Venezuela, contact United Oilwell Service. Or write Dowell Incoporated. Tulsa 1, Oklahoma.

*Service Mark of Dowell Incorporated

Services for the oil industry

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

the Gulf Coast area. James E. Plemons is district manager for the Louisiana area.

Kleinegger Named Sales Engineer by BJ Service

The appointment of James P. Kleinegger as sales engineer in the new BJ service station at Farmington, N. M., has been announced by W. T. Box, vice president in charge of operations for BJ Service, Inc.

Kleinegger has had special training and thorough experience in wire-line services, with particular emphasis on radioactivity logging.

Bank of Montreal Names Special Representative

Arthur C. P. Jones, attached to the assistant general manager's department of the Bank of Montreal in Vancouver for the past year, has been appointed a special representative of the bank's business-development department, with headquarters at Calgary. He will work with C. A. P. Leahey, B of M special representative in the bank's development operations in the oil fields of Alberta.

Jones joined the bank in 1927 and later served with a number of branches in Alberta. In 1950, as manager, he opened the B of M's branch at Whitehorse in the Yukon, where he remained until October 1955.

Du Pont Makes Petroleum Chemicals Appointments

W. S. CARPENTER

W. Samuel Carpenter III has been appointed director of sales of Du Pont's petroleum chemicals division succeeding David H. Conklin, who becomes managing director of the Du Pont Co. (United Kingdom) Ltd. Other personnel changes in the petroleum chemicals division resulting from the promotions are: Alfred R. Mullis, eastern regional manager, will replace Carpenter as assistant director of sales; Earl G. Bennett, now manager of the Central region, will become the new eastern regional manager; Donald W. Frison, manager of the Mid-Continent region, will move into the post vacated by Bennett.

Charles D. Towery, manager of the Gulf Coast region, will take over the management of the Mid-Continent region in addition to his present position. R. Carter W. Jones, sales promotion manager of the division, has been named to the new position of sales service manager. He will be responsible for the operations, sales promotion, export sales, office, and general sales sections. Harold C. Thompson, who is now assistant sales promotion manager, will succeed Jones as sales promotion manager.

Picou Becomes Manager at McCullough's Harvey Branch

Robert L. Picou, sales engineer for McCullough Tool Co. at Houma, La., has been transferred to Harvey, La., where he will serve as branch manager, according to O. J. McCullough, vice president of McCullough Tool Co.

Picou has had over 6 years' experience as an operating engineer. He was in the geophysical department of Shell Oil Co. for 9 years before joining McCullough.

BJ Tools Opens Pampa Sales and Service Office

To expedite service to the oil industry in the northern Texas and southern Oklahoma area, Byron Jackson Tools, Inc., has opened a sales and service office in Pampa, Tex., according to V. C. Horner, vice president and manager of sales.

The new Pampa office will be man-

200 GAS WELLS PROTECTED FROM CASING CORROSION

Problem. To protect the casing in more than 200 gas wells from external corrosion. These wells are in the Kansas section of the Hugoton gas field, and are operated by four companies. Six of the wells are in the sand hills area where soil resistivities are of the order of 20,000 ohm-cms.

Solution: CSI engineers made current requirement tests, and then applied cathodic protection using Galvomags—Dow's high-potential magnesium anodes.

Installations were designed to provide a guaranteed current output, with a minimum protection of 10 years. Current requirements ranged from 0.43 to 2.05 amperes. Costs averaged about $325 per well.

For expert consultation, engineering services or cathodic protection materials, call or write today. Estimates or quotations without obligation.

CSI

CORROSION SERVICES INCORPORATED

Tulsa, Oklahoma

P. O. Box 7343, Dept. J5 **Telephone: Circle 5-1351**

SAMPLES?

WET OR DRY?

CORE DRILLING?

Take your choice...anytime, anywhere...with a portable

FAILING CFD-1 COMBINATION RIG

for drilling with air or water!

Fast, versatile . . . this rugged, portable rig is especially recommended for seismograph shot holes. Allows recovery of wet or dry samples or cores as required. Send now for Bulletin 56-1 which gives detailed specifications of the Failing CFD-1 Combination Rig.

FEATURES IN BRIEF

1. Hydraulic pulldown drive maintains a constant bit pressure, gives a smooth feed and prevents breaking feed chains.
2. Pulldown has two ranges of speeds and free-wheel neutral.
3. Fewer controls for safe, easy operation.
4. Large friction clutches on drums for faster, safer handling of drill string.
5. Unitized assemblies for easy repairs and quick servicing.
6. Patented round fluted kelly for long wearing, smooth feeding drive. Easy to seal off when drilling with air.
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aged by James Deaton who was, until recently, in charge of the Wichita Falls, office. The latter office will be managed by H. Frank Smith. The Pampa and Wichita Falls offices are under the direction of regional sales manager, R. J. Evans, Jr.

J&L Names Johnson, Davis To Managerial Posts

Appointment of Don R. Johnson and Arthur C. Davis at Jones & Laughlin Supply Division's stores in the West and South Texas districts has been announced by A. G. Bastain, manager of field sales division.

Johnson, formerly a storeman at Hobbs, N. M., has been appointed manager of the J&L store at Sundown, Tex., West Texas district; Davis has been promoted from storeman to assistant local store manager at the firm's Houston store in the South Texas district.

Johnson has been with the division since 1952. Davis joined J&L's Houston store force in 1954.

Briggs Is Appointed GM Diesel Service Manager

D. H. BRIGGS

The appointment of D. H. Briggs as service manager of General Motors' Detroit Diesel Engine Division has been announced by Robert E. Hunter, general sales manager. B. W. Patrick, former zone sales manager in New York, succeeds Briggs as assistant service manager.

Briggs joined General Motors in 1935 and was engaged in experimental work on Detroit Diesel models for several years before production started. He was one of the original Detroit Diesel employes when the division was organized in 1937. Prior to his present appointment, Briggs was service representative and assistant service manager.

Dewey Supply Names Curry As Sales Representative

The appointment of Glenn Curry as sales representative for Dewey Supply Co. in the Tulsa area has been announced by M. B. Roach, president.

Prior to joining Dewey, Curry was with Iverson Supply Co. 10 years. He has had experience with the cable-tool trade of northern Oklahoma for the past several years.

Wisconsin Motor Announces Executive Appointments

RAY J. FELLOWS

F. B. ESTY

Ray J. Fellows, sales manager, and F. Burrows Esty, chief engineer, have been appointed vice presidents by Wisconsin Motor Corp. According to H. A. Todd, president, the appointments were made by the board of directors at the recent annual meeting of stockholders.

Fellows joined Wisconsin Motor Corp. in 1938 as a salesman, contacting major original equipment customers and distributors. In 1948 he was promoted to assistant sales manager and subsequently was appointed domestic sales manager, a post he has held since 1954 and which he continues to occupy as vice president.

Esty has been with the engine firm since 1948, joining as assistant chief engineer and succeeding to the post of chief engineer in 1955.

Thompson

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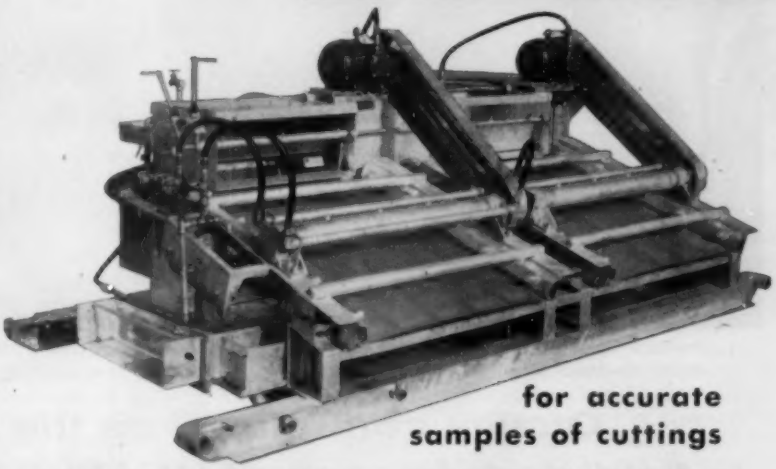

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and laboratory chair

SINCE the first days of the industry oil hunters have dreamed of a direct method of finding oil. The first pioneer in this field of course was the doodlebugger who claimed the ability to locate oil deposits by various and sundry means which bordered on the magical and the mysterious; among his tools were such things as the "wiggle stick," the "divining rod," and there were even those who claimed to be able to "feel" oil by body vibrations.

The geologist and geophysicist are still the oil-industry's great white hope for finding oil. And they have displayed an amazing adaptability and flexibility within their own fields of endeavor. No longer is the oil finder a graybearded professor with a pincenez on his nose, or a man of long-haired theory who may be regarded by the public as a crackpot. Today he is more likely to be the crew-cut college graduate with a vast storehouse of knowledge about the earth, how it got that way, and how to make it pay off with commercial production.

Geologists have learned to be skin divers, and they are searching the surface of the ocean floor for clues to present-day sedimentation in an effort to interpret the past. They are flying in helicopters and airplanes over previously inaccessible areas such as the Canadian Rockies, or the jungles of South America, and they have learned to pilot their own craft as a part of their duty. They are on ships in the waters of nearly every continent on earth, sounding out the ocean bottoms for possibilities of offshore production. Some of them are employing equipment which was unheard of 5 years ago, and they may resemble more a "man from Mars" than anything else.

Unceasing improvement . . . The established sciences of geology and geophysics continue to improve their methods and their approaches through extensive programs of research. Geophysics in the past 5 years has seen revolutionary new methods and equipment in its operations, and these changes may necessitate a complete resurvey of all previous work in all countries.

The research geologist, as mentioned earlier, is probing into the problems of facies change and sedimentation, both on land and under the sea. Exploration parties are invading the Arctic and the Alaskan lands. Electric-log experts are devoting new attention to study of holes that have already been drilled via many new methods of logging and well surveying.

The microscope of the paleontologist is an aggressive tool in ferreting out the age of different rock formations as the driller's bit cuts through; not only does he study fossil animals and microfossil remains but he is devoting great studies to fossil pollen and spores to determine the age of rock and to locate the shore lines of ancient seas.

Exploration activity for oil, then, is widespread and varied. And while it is all aimed at improvement of present methods, the subconscious search is still toward the magical, mythical tool that will enable man to spot an oil field before he drills a well. This has not yet come to pass; some authorities say that it will, while others scoff at the idea. Meanwhile, there is only one recourse still open to the oil hunter, and that is to drill a well at a spot recommended by his geologist and his geophysicist. **End.**

by Frank J. Gardner

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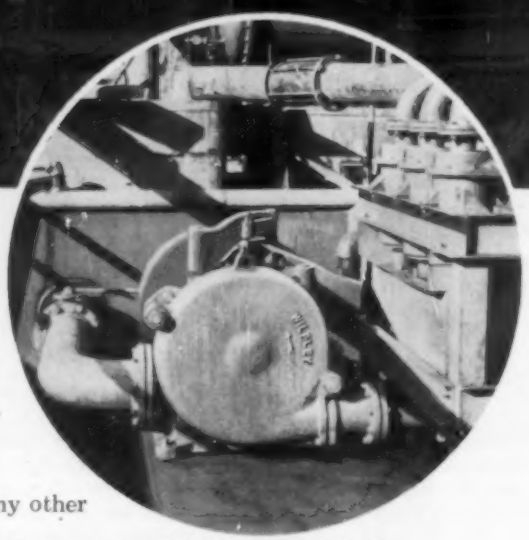

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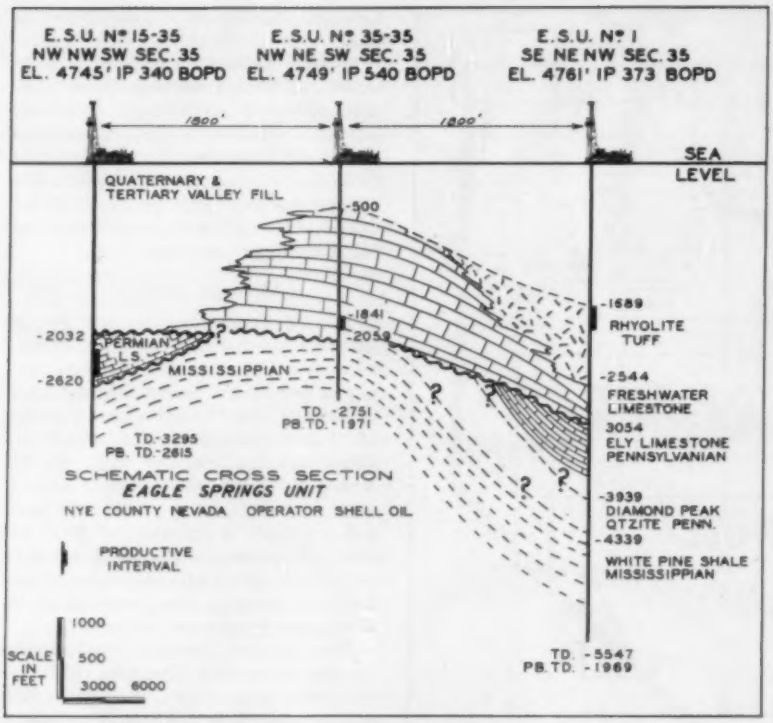


THE THREE OIL WELLS in the Eagle Springs Unit produce from three separate horizons. Since oil from all three zones is similar, it probably comes from a common source. Fig. 1.

What Does Nevada's Oil Promise for the Future?

by Joseph Lintz, Jr.

THREE years ago (February 1954) Shell Oil Co. announced its discovery of commercial quantities of crude oil in the Eagle Springs Unit, Railroad Valley, Nye County, Nevada. This announcement made Nevada the twenty-ninth state in which petroleum had been found. It opened for exploration a tremendous geologic province, the Basin and Range province. It embraces all of Nevada, western Utah, marginal portions of Idaho, Oregon, eastern California, and that part of Arizona lying west and south of the Colorado Plateau.

The initial response to this exciting news was the leasing of approximately 7 million acres in Nevada alone by individuals and companies interested in gaining a position in the future oil fields of Nevada. Since 87 per cent of Nevada is owned by the federal Government, the job of handling most of these leases fell to the Bureau of Land Management in Reno. Leases were the standard government forms; these call for the first year's rental with the filing fee, no rental for the second and third years, and full rental for each of the last 2 years.

The author is secretary of the Nevada Oil and Gas Conservation Commission. This paper was originally published in the February 1957 issue of the Rocky Mountain Oil Reporter.

Future Exploration

What is the status of oil exploration? And what does the future hold in Nevada as these leases come up for their fourth year rentals?

Let's examine first the events of the past 3 years in the producing pool, Shell's Eagle Springs Unit. The discovery well was the first test drilled by Shell in Nevada. Its drilling followed some 5 years of exploratory activity including study of the histories and geology of previously drilled wildcat holes, many crew-months of geological surface studies, and both reconnaissance and detailed seismic programs.

The evidence indicated to Shell's scientists the possibility of commercial quantities of petroleum in the black carbonaceous shales, some sandy horizons, and also some limestone formations of the Mississippian system.

The black shales were known to contain fossil remains where exposed on the surface. And of these fossils, a goniatite ammonoid, Cravenoceras, occurred frequently as oil-filled hollow casts. Oil-filled geodes had been found in these shales in other, distant localities.

Buried Anticline

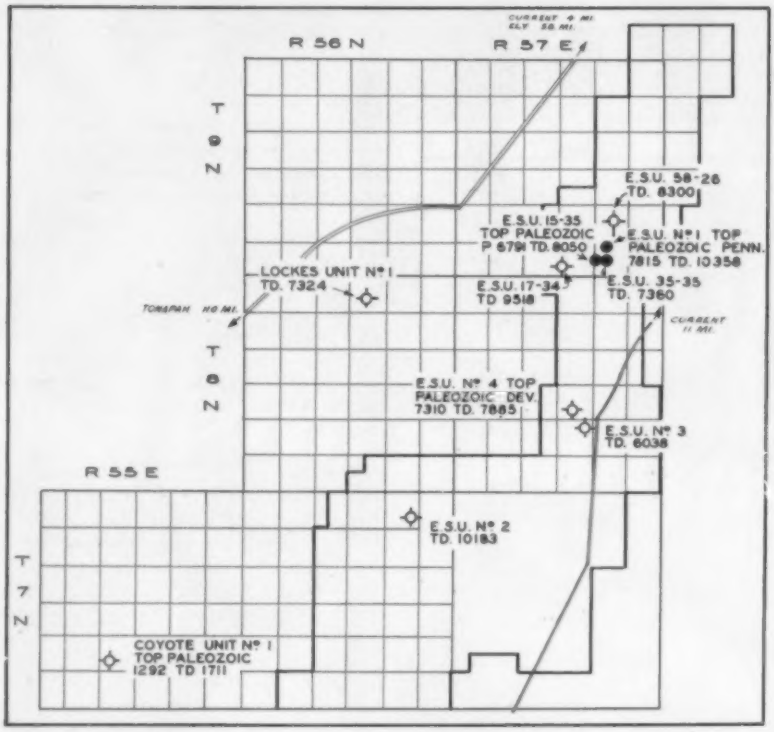
Shell avoided the mountain ranges which had been drilled in a few instances without success. Instead company geologists selected a geophysical anomaly, an anticline that was buried by detritus from an adjoining mountain range. The discovery well produces not from the expected Paleozoic horizons, but from a Tertiary welded tuff, containing oil in the joints and fractures. Prior to completing the discovery well, Shell entered an exploratory program based upon their seismic information.

Its long-distance stepouts along the anticlinal axis failed to find even shows of oil in most instances; it was obliged to drill stepout wells on less than 2,000-ft. spacings. Of this type of exploitation well, just two succeeded in finding additional oil. The producing horizon of each differs from that of the discovery well and from each other.

The discovery well produces from the Tertiary tuff; the second oil well, 35-35 Eagle Springs Unit, produces from a Tertiary freshwater limestone; and the last producer, 15-35 Eagle Springs Unit, draws its oil from a limestone reservoir containing abundant Permian foraminifera. These relationships are shown in Fig. 1.

The 1 Eagle Springs Unit was not placed on production until June 1954, with an initial production of 275 bbl. per day. It is currently producing 90 bbl. per day and shows a slow but continuing decline. The 35-35 Eagle Springs Unit, completed in March 1955, had a higher initial production; it, too, declined rapidly and currently is producing 45 bbl. per day. The 15-35 Eagle Springs Unit has been the weakest. It had an initial production of 300 bbl. per day in August 1955, and is currently producing at the rate of 25 bbl. of oil per day.

The accumulated production from this field as of December 31, 1956, is 161,000 bbl. The oil, a fine blend-



DRILLING ACTIVITY to date in the Eagle Springs area has been discouraging—three producers and seven dry holes. Fig. 2.

ing stock with a high (85° F.) pour point, has been trucked to Salt Lake City and Bakersfield. A steam plant at the lease tanks is necessary to load the trucks. Sufficient gas is produced with the oil to operate the steam plant.

Gulf Activities

Gulf Oil Corp. has been active in the search for oil in Nevada drilling seven dry holes between 1953 and 1955. Several additional holes were drilled in western Utah during the same period. Its play has centered about the petroliferous oil shales of the Tertiary strata in Elko County. These oil shales were mined and retorted during the 1920's in the vicinity of Elko, where they are capable of yielding about 1 bbl. of oil per ton.

Gulf's drilling program, backed by extensive geophysical and geological prospecting, has been generally discouraging. It has concentrated its drilling in an area where the Tertiary sediments are thick and gently warped into broad domes. Frequently the Tertiary structures have good surface expression. But with one exception, they lacked petroleum.

The one exception was the 1 Wilkins Ranch test in 21-38n-61e (No. 6, Fig. 3), which had good shows of oil at 6,510-32 ft. and 6,700-40 ft. These horizons are Tertiary (?), and consist of poorly cemented sands and conglomerates interbedded with shales. The many thin (1-2 ft.) porous lenses were saturated with oil, but the aggregate of the porous strata was insufficient to produce in commercial quantities. Many of Gulf's tests drilled into the Paleozoic sediments, usually well into the Mississippian system.

The Richfield Oil Corp. 1 Rabbit Creek unit test (No. 8, Fig. 3) was drilled as a farmout from Gulf and was a part of this over-all drilling program.

Fourteen additional dry holes have been drilled by independents in their attempts to find oil. Most of these plays were undertaken with little or no geologic advice. And in no instance was geophysics employed as a guide to well-site selection.

Geologic Factors

What then are the geologic factors to be considered in drilling within Nevada or the Basin and Range Province in general? First, stratigraphy; second, tectonics. The Basin and Range Province contains a nearly complete sequence of Paleozoic geosynclinal deposits. Nolan (1943) has published the best general paper on the region. Because of the excellent summaries of Paleozoic stratigraphy by E. R. Larson (1954) and Nolan, Merriam, and Williams (1956) it is not necessary to repeat here the detailed formational descriptions. Van Houten (1956) has recently published the results of his Cenozoic sedimentary rock investigations.

Possible petroleum reservoirs might well occur within the thin sandy horizons deposited in the upper Paleozoic sections, especially in the Mississippian and basal Pennsylvanian systems; the Devonian carbonate beds possessing vuggy porosity; and perhaps in the eastern, or carbonate assemblage of the Ordovician system.

Mesozoic Deposits

The Mesozoic deposits are greatly reduced in areal and temporal extent. In eastern Elko and White Pine counties a very hard phosphatic dolomite resembling the Phosphoria formation of Wyoming crops out in erratic residual patches. To the west, in the Tonopah - Hawthorne-Gabbs - Lovelock area, the Triassic is well developed and exposed; it consists of dark-colored calcareous shales. In the Lovelock area, two facies assemblages occur and thrusting has mixed them in a complex variety of relationships.

The Jurassic system, consisting of marine shales and limestone with interbedded pyroclastics, is represented in this same region. Cretaceous deposits throughout the northern and central part of the state consist of lacustrine deposits of considerable but erratic extent.

In the Las Vegas region, the Mesozoic deposits are more readily identified with the Colorado Plateau deposition; the Moenkopi, Shinarump, and Chinle formations of the Triassic, as well as the Aztec (Navajo) sandstone of the Jurassic are recognized. The Cretaceous deposits here are confined to the Muddy Mountain area. They are thicker and better developed than at any other point in the state. They appear to have been deposited in a terrestrial environment.

Cenozoic Times

During the Cenozoic era, Nevada was above sea level at all times so no marine deposits are known. The earlier Tertiary sediments include freshwater limestones and shales. Later Tertiary rocks include flow materials of all compositions, coarse gravels, the oil shale of Elko County, and fine-grained clastics and pyroclastic sediments.

In the intermountain basins, these more or less well-bedded sediments are buried beneath great thicknesses (up to 7,500 ft. known today) of Quaternary valley fill, erosional debris from the mountain regions. The source of the petroleum found to date in Tertiary sediments is as yet unsolved and constitutes one of the major problems facing exploration geologists in the Great basin.

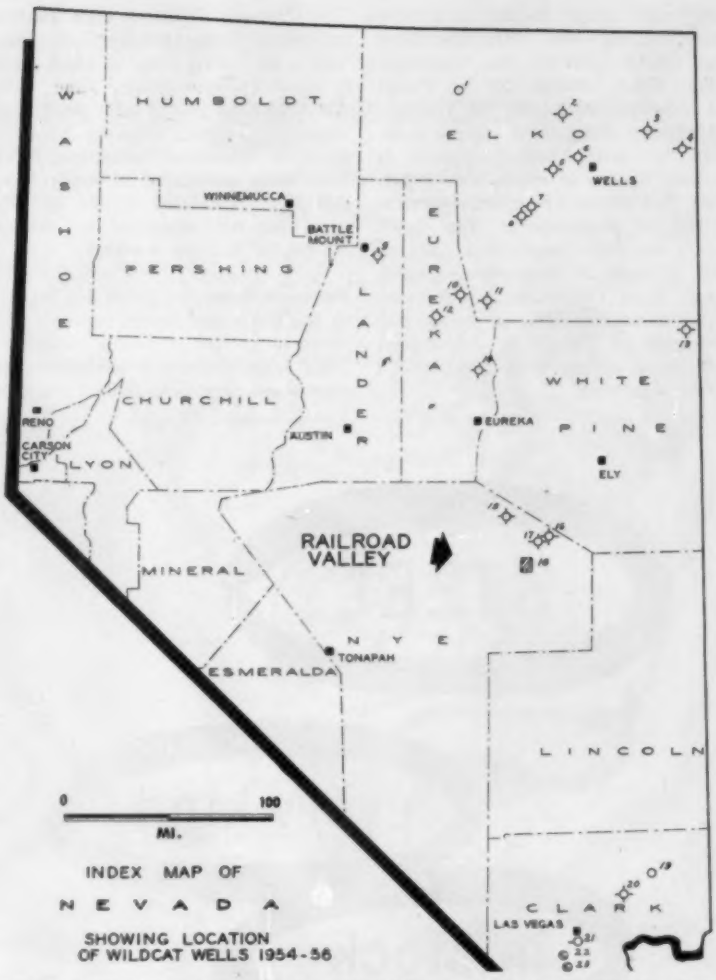
The stratigraphic picture of the

Great basin has emerged in reconnaissance style in the past decade or so, but there are many areas needing additional detailed work. The tectonic situation is dependent upon stratigraphic knowledge. Consequently the structural picture is less well understood. Nevertheless, many data have been developed in recent years that have not been published.

Probably the best-published sources of information on the tectonics of Nevada are the various geologic quadrangle maps of Ferguson, Muller, and Roberts (1951-52); these show detailed mapping in four adjacent 30-minute quadrangles. As new evidence has appeared, the authors found it necessary to shift their interpretation so these maps must be used with caution by those not familiar with Nevada geology.

Thrust faulting . . . In the area covered by these maps, thrust faulting is unbelievably complex, and extended over a very long segment of geologic time. The zone of thrusting extends across Nevada from the Silver Peak area southwest of Tonopah to Mountain City on the Idaho border, north of Elko. Gilluly believes this to be a portion of a zone extending from the Invo ranges of California across Nevada, eastern Idaho, and western Montana (James Gilluly, oral communication July 28, 1955).

The earliest-known thrust faulting commenced during the late Mississippian period; and, within the zone under discussion, faulting continued intermittently until at least Jurassic time. R. J. Roberts has found evidence of



INDEX MAP of Nevada shows the wildcat-drilling activity during 1954-56. Well numbers refer to Table 1 below. Fig. 3.

TABLE 1—WELL DATA

No.	Operator, well, and location—	Date	TD (ft.)	Surface Fm.	Lowest Fm.	Remarks
1.	Richfield 1 Scott-Gov't, 22-43n-52e	1956	Drlg.	Tertiary		TD 2,584 ft. at end of year
2.	Gulf 1 Mary's River-Fed, 16-41n-60e	1955	6,612	Tertiary	Ordo (?)	Good surface structure. Top of Paleozoics (Ordo.?) 6,475 ft.
3.	Gulf 1 Thousand Spg. Unit, 8-40n-66e	1954	8,412	Quaternary	Miss. (?)	
4.	Gulf 2 Wilkins Ranch, 19-39n-69e	1954	4,938	Quaternary	Paleozoics (?)	Top Paleozoics (?) 4,707 ft.
5.	Gulf 1 Pete Itcaina, 8-37n-59e	1954	5,465	Quaternary	Miss. (?)	
6.	Gulf 1 Wilkins Ranch, 21-38n-61e	1954	8,414	Tertiary	U. Dev. (?)	Excellent oil shows
7.	Inland 1 Itcaina, 31-36n-58e	1954	830	Quaternary	Tertiary	
	Inland 2 Itcaina, 31-36n-58e	1954	800	Quaternary	Tertiary	
	Inland 3 Itcaina, 31-36n-58e	1954	400	Quaternary	Tertiary	
8.	Richfield 1 Rabbit Crk. Unit, 11-34n-57e	1956	7,349	Tertiary	Miss.	Top Permian: 3,070 ft.
9.	J. D. Blalock 1 Voorhees, 34-32n-45e	1956	4,300	Quaternary	Tertiary (?)	
10.	Nepple & Ebert 1 Gov't, 3-27n-52e	1954		Tertiary	Devonian (?)	
11.	Diamond 1 Conquest, 15-26n-54e	1954	1,072	Tertiary	Unknown	
	Diamond 2 Conquest, 3-27n-54e	1954	620	Tertiary (?)	Unknown	
	Diamond 3 Conquest, 3-27n-54e	1954	....	Tertiary	Unknown	
12.	Last Frontier 1 Damele, 6-26n-51e	1956	Drlg.	Quaternary		Tert. shows of oil. TD 3,500 ft. at end of year
13.	Gulf 1 Dennison-Federal, 20-26n-70e	1954	4,438	Tertiary	Permian	Top of Permian: 2,215 ft.
14.	Shell 1 Diamond Valley, 30-23n-54e	1956	8,042	Quaternary	Paleozoics	Top of Paleozoics: 7,475 ft.
15.	Signal-Tillman 1 Halstead, 27-12n-56e	1954	325	Quaternary	Tertiary (?)	
16.	West End Opoteca Mines 28-1 Federal, 28-11n-60e	1956	Drlg.	U. Paleo. (?)		TD 405 ft. at end of year.
17.	Bandini 1 Harris-Fed., 25-10n-57e	1954	5,552	Quaternary	Devonian	Top of Paleozoics: 5,550 ft.
18.	Shell Oil Co. Railroad Valley activities. See Fig. 2.					
19.	Moapa Nev. O. & G. 1 Logandale, 21-15s-67e	1956	Drlg.	Quaternary		TD 575 ft. at end of year
20.	S. Great Basin 1 Federal, 17-17s-65e	1954	5,085	Quaternary	Tertiary (?)	
21.	Joe W. Brown 1 Wilson-Fed., 24-21s-61e	1956	Drlg.	Quaternary		Several oil shows. TD 7,082 ft. at end of year
22.	U. S. Oil Co. 1 Wilson-Fed., 27-22s-60e	1956	Drlg.	Quaternary		TD 2,026 ft. at end of year
23.	Smithdeal 1 Federal, 17-23s-61e	1956	Drlg.	Miss. (?)		TD 306 ft. at end of year

at least eight major thrusts in western Nevada during this 120-million-year period and is confident that additional smaller faults remain to be found (oral communication, July 29, 1956).

Movement along these thrusts is towards the east. Their magnitude is measured in tens of miles, with a possibility that 100 or 110 miles represents the greatest displacement. The thrust zone is also the locus of a zone of facies changes in formations ranging in age from Ordovician to Jurassic; the sediments to the east being predominantly a carbonate assemblage, while those to the west contribute a clastic assemblage.

A Cenozoic thrusting with southerly movement is reported by C. R. Longwell in the Spring range of Clark County (oral communication, June 1953). Although this is the only positive instance of Cenozoic thrusting, from time to time additional Cenozoic thrusts have been postulated in many localities. The postulated thrusts of other areas are not supported by evidence acceptable to most workers.

Paleozoic folds . . . Folds are common in the Basin and Range province, particularly in the Paleozoic sediments. They usually show a northeast-southwest trend parallel to that of the thrust zone, and are usually closed or isoclinal. Many tight folds become overturned or recumbent where deformational stresses are even more severe. For the most part Paleozoic sediments exhibit no broad, gentle structures such as are known in the Colorado Plateau and Rocky Mountain regions.

An area of eastward trending structures is recognized in the Mountain City-Contact region of northern Elko County. The sediments here are Mississippian or older, indicating this period of deformation occurred prior to the thrusting. Cenozoic folding has produced a number of gentle, open structures; to date these have proved barren of oil where drilled in the wide intermountain valleys.

Basin and Range faulting . . . The most-recent tectonic event is the extensive Basin and Range faulting. And this gives the province its typical aspect. This activity commenced early in the Tertiary period, and evidence afforded by recent Nevada and California earthquakes attest to the continuance through the present. The magnitude of this normal faulting is on the order of 10,000 to 12,000 ft. maximum displacement.

These nearly north-south faults have developed irrespective of the alignment of all previous deformation. As the ranges were lifted erosion began to provide material which was transported into the basin. Thus, in the basin and range province, bedrock geology is masked by these young deposits in at least 50 per cent of the province, leaving geologists only a series of isolated mountain ranges to work with and study. Another 5 to 10 per cent of the province is masked by young extrusive flows.

Until he possesses two keys, the petroleum geologist stands little chance of attaining a discovery dry-hole ratio in Nevada approaching that of other petroliferous regions. The first key is the positive determination of the source rock of the oil currently being produced in Nevada; the second key is the ability to employ geophysical exploration techniques successfully in these intermountain basins. The first key is basic and fundamental; the problem centering on the second key could be mitigated, as we shall see, depending upon the age of the petroleum.

Source of the oil . . . Current Nevada production from the Eagle Springs Unit is obtained from Tertiary pyroclastic, Tertiary freshwater limestone, and Permian marine limestone (Fig. 1). Because the physical properties of the oil from the three rock units is identical, the oil undoubtedly comes from a common pool. The presence of

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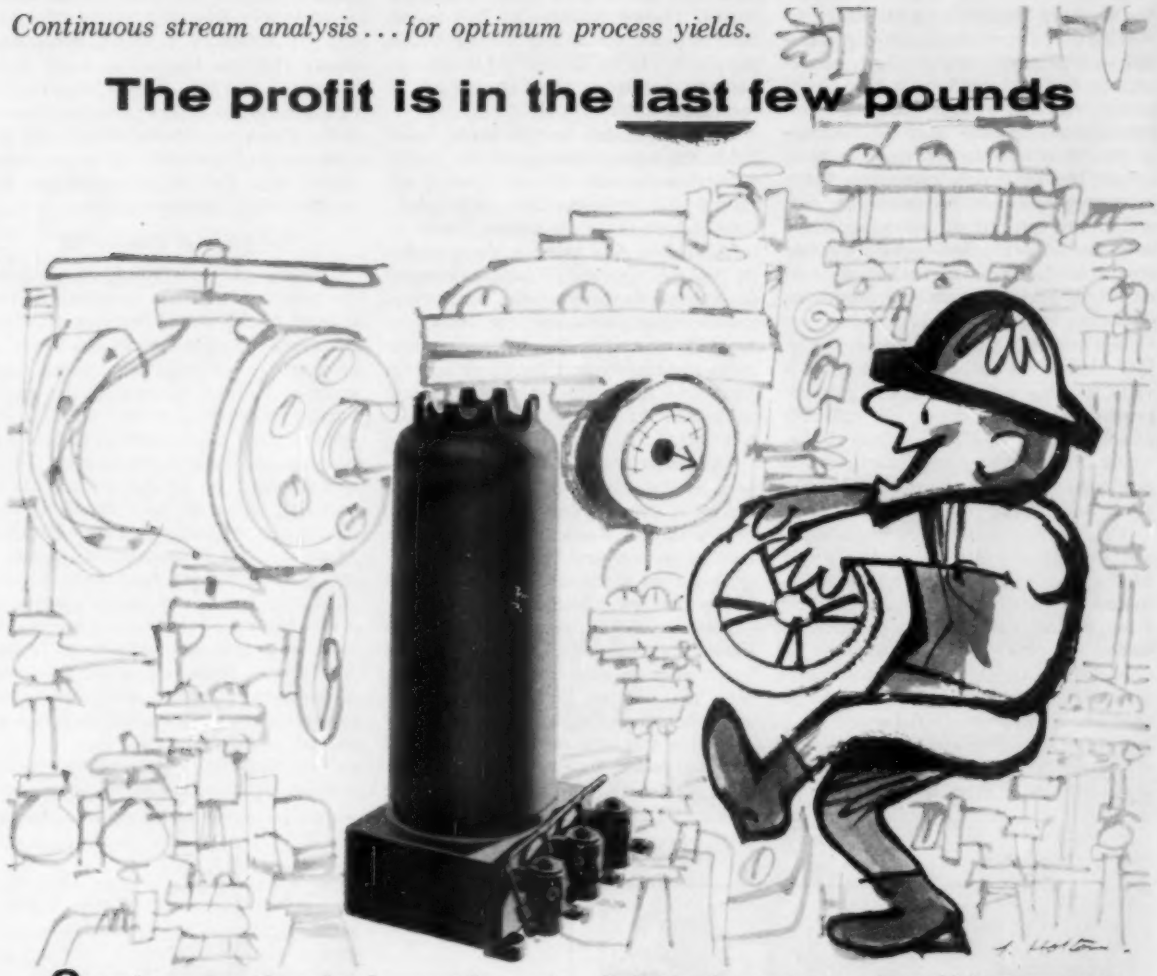

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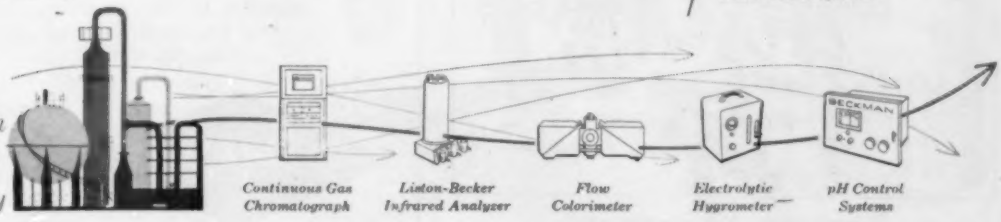


Continuous Gas Chromatograph — *Liston-Becker Infrared Analyzer* — *Flow Colorimeter* — *Electrolytic Hygrometer* — *pH Control Systems*

oil in pyroclastic rock indicates migration from an unknown source bed.

What is our present knowledge concerning possible source beds from whence the oil could have started its journey to the present location? The petroliferous geodes and ammonoids of the Mississippian system have been noted. This system is present in three producing wells not far below the reservoir intervals. In the abandoned dry holes the Mississippian rocks are either absent or far beneath rock units tentatively correlated with the producing intervals.

This suggests that the operator's original theory in choosing this site is valid. On the other hand, the physical properties of the crude oil resemble closely those of Utah's Uinta basin, where high pour-point petroleum is produced from Tertiary basal Green River and upper Wasatch formations.

The brilliant research of Hunt, Stewart, and Dickey (1954) on the origin of the Uinta basin crude oil has eliminated the belief in vertical migration from the marine Cretaceous sediments underlying the reservoir horizons at considerable depth at that locale. It is difficult to dispute the interpretation that the petroleum was formed in a lacustrine environment. In this instance it would appear that the once-fresh water of the Eocene lakes became increasingly saline until it approximated normal marine salinity. At this point, the restricted conditions during which petroleum can be formed prevailed, apparently for more than an instant of geological time.

We have today in the Uinta basin fields the accumulations of the petroleum then formed. If this tenet is accepted, it's probable that such conditions could occur in other places at other times. And there is the possibility that the Miocene (?) lake beds in the Basin and Range province meet these requirements. Certainly the oil shales near Elko support the tenet for a locality reasonably near the Eagle Springs Unit and in sediments approximating the age of the reservoir rocks of E.S.U. well No. 35-35.

Until such time as one of these theories is discredited, or some additional theory is proved, the petroleum possibilities of the Basin and Range province in general and Nevada, specifically, must be discussed from these two points of view. Assuming that the petroleum is of Paleozoic origin, it seems likely that future discoveries will be centered in the eastern part of the state, with the western limit of exploration near the zone of thrust faulting.

Within this area of 100,000 to 150,000 sq. miles, it would be logical to seek conditions similar to those of the Eagle Springs Unit. Shell's exploration of an area in Diamond Valley (No. 14, Fig. 3) which it believed duplicated these conditions resulted in a dry hole in the fall of 1956. This represents the first attempt to follow this line of attack. This approach emphasizes the intermountain basins and brings us to the second key, that of improving the interpretation of geophysical data.

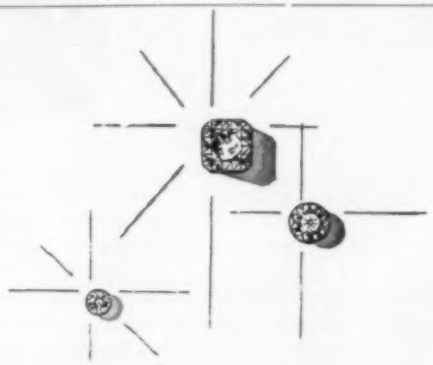
Geophysical Prospecting

Geophysical prospecting has led to the discovery of large quantities of petroleum under widely varying geologic circumstances. One important factor is common to all situations where seismicity has been employed; the overburden of masking rocks tended to be bedded units having relatively continuous top and bottom boundaries. They are sheetlike or tabular bodies. It is true that some of them show regional changes in thickness or facies changes. Many difficult local obstacles concerning the overburden have been solved.

In the Basin and Range province, some bedded Tertiary sediments are known to exist in many of the basins. But above them lie relatively great thicknesses of highly lenticular deposits having tremendous vertical and horizontal irregularities.

This masking consists of numberless alluvial fans; these coalesce, interfinger,

"Congratulations, J. B.—another well!"



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and are stacked one on the other in every conceivable relation. Intercalated among them are extrusive flows of various sizes and shapes which can mislead the geophysical interpreter. A wide variety of cementing factors can change rapidly over short distances, endowing the deposits with a great range of physical properties. Certainly, as experience is accumulated and if the rewards are sufficient, this obstacle will be overcome. Today, however, the task appears formidable.

Mountain Ranges

The same pre-Cenozoic structures and stratigraphy occur in the mountain ranges unmasked by Cenozoic deposits. In theory, if the oil originates in Paleozoic rocks, the mountain ranges should be as desirable for drilling sites as the basins. Drilling by major operators during 1949-1952 produced oil shows in several localities, but nothing approaching commercial accumulations. Although only three or four wildcats have been drilled in the Nevada ranges, and another four or five in western Utah, there is little interest in this type of play at present.

One other possibility for petroleum accumulations from Paleozoic source beds is fault traps within or along the thrust plates. Since this type of play presents special additional problems, it is not likely to be attempted in the immediate future.

Paleozoic rocks . . . West of the thrust zone, Paleozoic rocks crop out only in localized areas and appear to be metamorphosed. Generally they are buried by as much as 25,000 or 30,000 ft. of Mesozoic and Cenozoic deposits. Consequently, they are beyond our present technologic reach. Metamorphism increases as the Sierra Nevada Range is approached, reducing Paleozoic possibilities of the western portion of the Basin and Range province.

This picture changes radically, however, if it can be demonstrated that the Eagle Springs oil is of Tertiary age. In the western portion of the province, wide basins with thick accumulations of Cenozoic deposits occur; of these, the Carson and Humboldt sinks serve as examples.

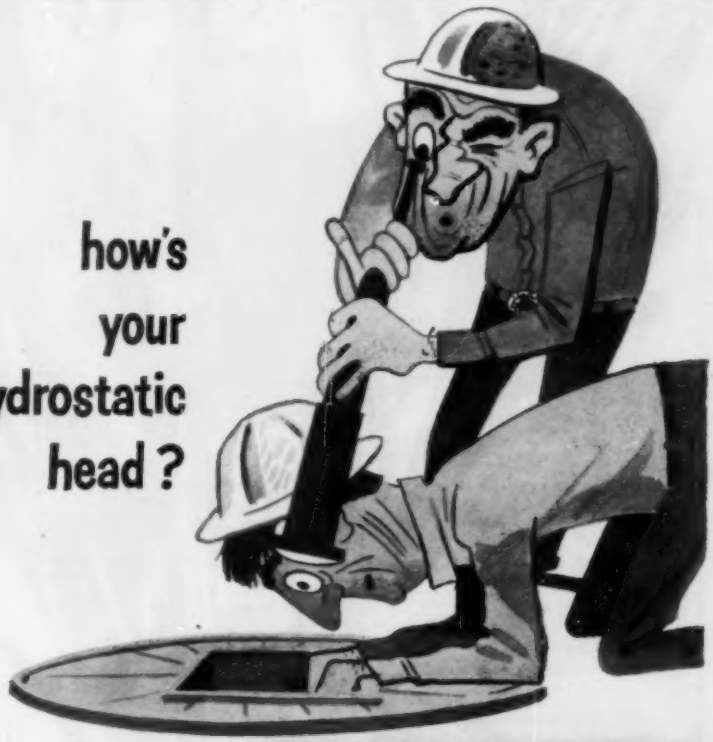
In these areas, sedimentary processes may have been more uniform. Consequently, seismic investigations may not encounter the alluvial fan jumbles existing elsewhere. Marsh gas is produced in minor amounts from shallow depths in the Carson sink. Thirty years ago, a 3,200-ft. wildcat failed to find any hydrocarbons below these shallow horizons, but did not completely penetrate the Tertiary deposits. Outcrops of pre-Pleistocene lacustrine deposits are known about the margins of these basins, but their continuance basinward has yet to be established.

Pre-Pleistocene Deposits

Pre-Pleistocene lacustrine deposits are present in many intermountain valleys in eastern and Central Nevada. In Clark County, they have been found in one or two of the deeper wildcat tests. If the oil is proved to be formed in Tertiary sediments, these scattered areas could possess an important oil potential.

Because of the exploration difficulties and the scant rewards obtained to date, the tempo of petroleum exploration in the Basin and Range province is relatively slow. Currently there are too many other regions offering greater prospects for petroleum discoveries. Major operators are required to concentrate their efforts in these regions to maintain their competitive positions.

Too many independent operators in the Basin and Range province are unable to conduct sufficient research prior to drilling, or unable to carry their drilling operations to optimum horizons to provide critical information to add to our geologic knowledge of the Great basin. Until additional strikes are made, it would appear that there is lit-



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tle impetus to increase the exploration tempo in Nevada and those portions of the adjacent states lying within the basin and range province. William T. Smith's (1956) appraisal, "Nevada still promising—but unproved," remains valid.

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EXPLORATION HIGHLIGHTS

APPALACHIAN

OHIO

Rochester and Lamp are attempting to renew production in Union Furnace field, one of the oldest in the state. Their 1 (9) J. D. Loomis, Section 17, Starr Township, Hocking County, found Clinton sand at 3,221-69 ft., with 1 bbl. natural and 50 bbl. in 24 hours after fracture.

● The north offset to the gas discovery on 1 E. Kasner, Section 7, Monroe Township, Coshocton County, Ditch and Hanna 1 Henry Kasner, gaged 8 bbl. natural and 275 bbl. in 24 hours after fracture. Clinton sand was logged at 3,240-58 ft.

● Waverly Oil Works 1 Basil Norris, Section 4-N, Hopewell Township, Muskingum County, a northeast offset extension to Cottage Hill pool, gaged 10 bbl. natural and 75 bbl. after fracture from Clinton at 3,283-3,323 ft.

PENNSYLVANIA

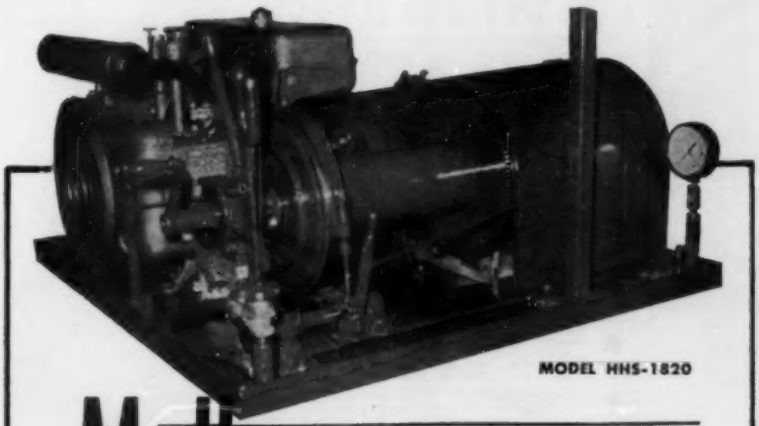
In Armstrong Township, Indiana County, Southwest Pennsylvania, Manufacturers Light & Heat Co. 4431 R. & P. Coal Co., wildcat, elevation 1,203 ft., was dry, Tully 6,820 ft., Onondaga 7,685 ft., TD 7,779 ft.

● No. 4430 by this company on R. & P. Coal Co., shut down at 7,777 ft., to refracture. The Onondaga in this well was at 7,558 ft., chert 7,585 ft., with gas, Oriskany sand 7,750 ft.

● Mt. Pleasant Township, Westmoreland County, Peoples Natural Gas Co., 4109 B. H. Smithley, elevation 2,001 ft., shut down at 7,539 ft., chert 7,364 ft., gas testing 3,000,000 cu. ft., Oriskany sand 7,497 ft.

Exploration This Week

Appalachian	251
Rocky Mountains	252
Louisiana	256
Oklahoma	256
Kansas	256
Canada	259
California	259
Texas	259
Successful wildcats	260



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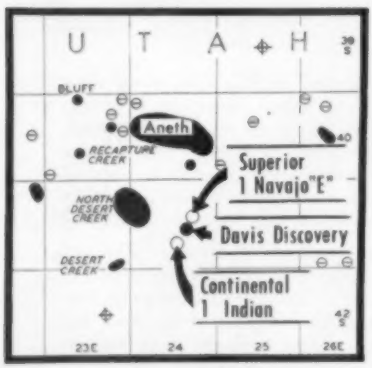

Davis Oil Co. completed the discovery well of "East Desert Creek field" in San Juan County, Paradox basin. The 1 Navajo "A," C NE NE 27-41s-24e, flowed 1,680 bbl. of oil daily from Paradox-Pennsylvanian perforations. Two offsets were quickly announced. Continental Oil Co. 1 Indian, ¼ mile southwest, and Superior Oil Co. 1 Navajo "E," ¼ mile northeast.

The discovery forms a triangle with North Desert Creek and Desert Creek field. There has been no drilling between the sides of the triangle.

ROCKY MOUNTAIN

UTAH

Featherstone Discovery Completed in San Juan

Pan American Petroleum Corp. has the latest oil discovery well in the Paradox basin. The 1 Featherstone, NW SW SW 24-40s-22e, San Juan County, flowed 273 bbl. of oil per day on 20/64-in. choke from perforations at 5,405-36 ft. Production is from the Pennsylvanian.

Location of this newest Paradox strike is 3½ miles west of Recapture Creek field and 2½ miles northwest of West Desert Creek field. It is the westernmost producer in the Aneth area.

Confirmation at West Desert Creek Completed

The important confirmation well to new West Desert Creek field in San Juan County was completed flowing 210 bbl. of oil and 183 M.c.f. of gas daily on 14/64-in. choke. The well, Gulf Oil Corp. 2 Desert Creek Federal, C W½ NE 1-41s-22e, is southwest of the Hermosa field discovery well, an early 1957 strike that made 263 bbl. per day on 12/64-in. choke. Production at the confirmation well is also Hermosa-Pennsylvanian.

Flank Oil Co. et al 1 Bugbee, NW SE SW 6-33n-6w, is an indicated Mississippian oil discovery in the Cadmus Dome area of Glacier County. The well flowed 25 bbl. of oil in 1 hour on drill-stem test at 4,625-43 ft. Top of the Lodgepole is 4,305 ft. Gas flow measured 1,300 M.c.f. daily. Location of this strike is 4 miles west of Cut Bank field, a Cretaceous and Mississippian producer. The Cadmus Dome is on the Sweetgrass arch, major structural feature of northwestern Montana.

NEW MEXICO

NORTHWEST NEW MEXICO

Gallup Pool Opened 13 Miles Southeast of Bisti

Lion Oil Co., a Division of Monsanto Chemical Co., has announced the completion of the 1 Atlas as an oil discovery well in San Juan County. This is the company's first oil production in the San Juan basin.

The well, completed on pump, produced 110 bbl. of 41.1°-gravity oil on a 24-hour test. Production is from the lower Gallup sand through perforations from 5,362 to 5,412 ft.

Located about 30 miles southeast of Farmington, N. M., and 13 miles southeast of Bisti field, the well was drilled in 34-25n-10w. The company has leases on 480 acres in the immediate vicinity.

• Kenneth Murchison 1 Mims-Carson, E½ NW NW 4-24n-12w, San Juan County, was completed for 8 bbl. of oil per day from the Gallup at 4,338-4,436 ft. to open a small pool 2 miles south of similar production in 29-25n-12w.

Ohio Oil Co. 22 Samuel, deep test in Park County's Oregon Basin field, flowed gas at the estimated rate of 4,500 M.c.f. per day on drill-stem test of the Flathead-Cambrian at 6,159-74 ft. Previous tests in Cambrian flowed gas. Other Cambrian production in Wyoming is at Lost Soldier and Wertz in the Red Desert basin, and at Poison Spider in the southwest Wind River basin. The 22 Samuel is a deepened Madison oil well in Oregon Basin field.

Abstracts

HERE is the first group in a series of selected abstracts from the February Rocky Mountain Association of Petroleum Geologists meeting in Salt Lake City.

Keynote Address
The Discovery Challenge Of the Rockies

DR. A. I. LEVORSEN, past president A.A. P.G.

THERE are two basic questions one must answer for each region in which he plans to explore. They are: (1) Is there petroleum yet to be discovered? and (2) Can it be discovered? For many reasons, the first can easily be answered "yes" for the Rocky Mountain region. The second remains the challenge.

Exploration for petroleum in the average region generally follows a recognizable sequence or pattern that consists of three phases. Phase 1 is exploration for petroleum in purely structural traps. Phase 2 is exploration in combination structural and stratigraphic traps, and Phase 3 is exploration in purely stratigraphic traps. It would appear from the theme of this convention that the geologists here feel they may be moving out of Phase 1, the structural period, into Phases 2 and 3, the periods of increasing stratigraphic importance.

The gradual shifting of attention from purely structural traps into traps that are determined more and more by stratigraphic anomalies is but a normal development. It has been delayed somewhat in the Rockies, chiefly because of the large original supply of structural traps.

Suggestions of types of some traps with a stratigraphic element that could successfully answer the challenge of discovery are given. Exploration for traps of these types means a change in geologic thinking, a much greater emphasis on precise geologic data, more imagination in exploration, and more courage to drill the less obvious traps. To some, the golden years of petroleum in the Rockies are in the past, but to others, with equal logic, the golden years are yet ahead. The challenge of discovery, it seems, has an almost sure chance, geologically at least, of being answered with abundance.

Clastic Reservoirs of the Post-Precambrian Interval

J. C. SPROULE, J. C. Sproule & Associates, Calgary.

CLASTIC reservoirs of the post-Precambrian interval have recently gained a prominent position in the eyes of the petroleum and natural-gas industry with the discovery of several commercial and indicated commercial oil occurrences in northern Alberta. The reservoir there is commonly referred to as Granite Wash. Elsewhere in Canada and in the northern United States, equivalent reservoirs are widespread and are known by various names.

The Granite Wash and its equivalents are, in this paper, defined lithologically and their age relationships to overlying and underlying rocks discussed, with particular refererence to the possible origin, lithology, structure, paleotopography and tectonic history of the underlying Precambrian surface on which they depend for their occurrences and developments as reservoirs. The anticipated future in Canada as well as in the northern United States, with particular reference to the part that should be played by geophysics, is discussed.

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Nature of Rocky Mountain Stratigraphic Fields

BRUCE F. CURTIS, Continental Oil Co., Denver; **ROBERT K. KIRKBRIDE,** Gulf Oil Corp., Denver; **WILLIAM S. McCABE,** consulting geologist, Denver; **M. DANE PICARD,** St. Helens Petroleum Corp., Casper; **FRANK I. PRITCHETT, JR.,** Great Western Drilling Co., Farmington, N. M.

IN recent years, the number of stratigraphic fields discovered in the Rocky Mountain region has increased markedly. A classification of these fields according to lithology and the origin of porosity in their reservoir rocks reveals some patterns regarded as useful in guiding additional exploration. Among the fields with carbonate reservoirs, those producing from fragramental rocks are most numerous. North Westhope field in North Dakota is an example.

Most common of the siliceous reservoir rocks are those deposited in nearshore environment. Sand River field in eastern Colorado is characteristic of fields so classed. Statistically it appears that the best of Rocky Mountain stratigraphic fields are those with Cretaceous sandstone reservoirs of beach-bar type such as Bisti field in New Mexico's San Juan basin.

Stratigraphic Traps in the Denver Basin

HARRISON F. MURRAY, consulting geologist, Boulder, Colo.

THE major oil and gas fields of the Denver basin produce from the D and J zones of the Lower Cretaceous Dakota sandstone. Lateral and vertical variations in grain size and permeability of these members localize oil accumulations both in conjunction with the independent of structural anomalies. Although only about half the fields may be classed as stratigraphic traps, some of the most prolific producers, Adena, Little Beaver, Harrisburg, and Bobcat are stratigraphically controlled.

In the producing area, the D zone is a continuous siltstone body containing local lenticular and shoestring sandstones. The J zone is a more continuous sandstone containing numerous silt and shale barriers near the top of the zone.

Stratigraphic traps in the D and J zones are divided into five classes based upon the form of the reservoir: (1) isolated sand lenses; (2) shoestring sand bodies; (3) updip barriers in sand bodies; (4) updip drop in roof of reservoir sand; (5) erratic cementation of sand.

Facies Approach to Reef Exploration in Central Alberta

JOHN M. ANDRICHUK, Andrichuk and Edie, consultants, Calgary, Alta.

FRAME-BUILDING stromatoporoids, algae, and associated amphiporids and corals are concentrated in definite bands in the upper part of the Upper Devonian Leduc limestone at Redwater field. An algal belt, trending northwest-southeast and developed along the northeast edge of the Redwater reef, is interpreted as a reef front aligned perpendicular to the ocean currents and possible prevailing winds. Thus, algae bound the stromatoporoidal organic lattice at the eastern fore-reef margin. A poorly fossiliferous precipitated limestone facies is developed west of the organic lattice.

In central Alberta, the Devonian biohermal reefs formed on a broad carbonate foundation (Cooking Lake platform). Several miles east of and subparallel with the Redwater bioherm, the Cooking Lake limestone contains an algal and stromatoporoidal biofacies belt. This belt, representing an incipient reef front or biostromal margin, exhibited a progressive westward migration from early to late Cooking Lake and subsequent late Leduc times.

In the Leduc area, the Leduc reefs and their biostromal foundations are essentially completely dolomitized and most of the lithologic and paleontologic features are obscured. However, vestiges indicate the original rocks to have been shallow and agitated water limestones bearing potential frame-building organisms. Thus, the dolomitization pattern of the foundation unit may be used to outline depositional shoals favorable for initiation of reef growth.

Calcarenite and fossil distribution patterns may be extrapolated from known reefs to map possible extensions or nearby separate masses. Hence these patterns may be employed in assisting development of reef fields.

In wildcat areas, reef prospects may be delineated as follows: Firstly, the proportion of agitated water calcarenites and secondary dolomites are used as indices in defining prominent shoals that existed during deposition of the foundation unit. Secondly, the ratio of potential frame-building organisms to other fossils is used to construct the biofacies pattern within shoal areas. Thirdly, possible loci of algal-stromatoporoid concentrations are mapped within the most favorable biofacies. This procedure permits a reef prospect to be localized to a relatively small part of the favorable shoal and considerably lesser part of the total wildcat area.

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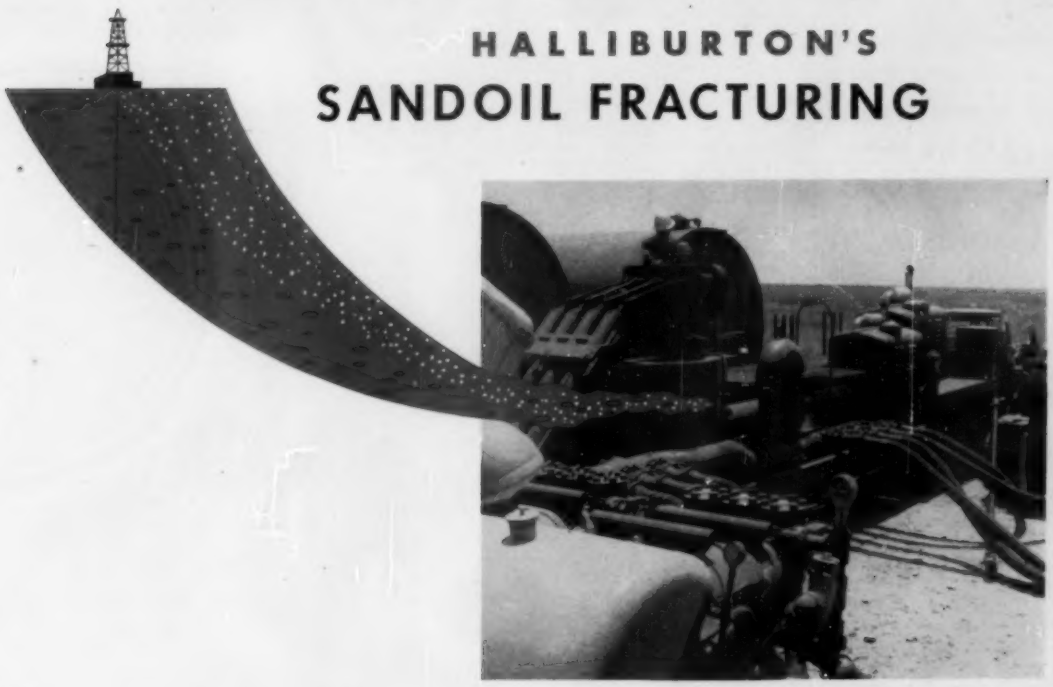

The fact that SANDOIL fracturing is economical for big volume jobs means that comparable economy is also possible where smaller volumes of fluid and propping agent are required. Inexpensive, readily obtainable crude or refinery cuts and blends are used for the fracturing and carrying fluid. Emulsion problems are minimized by chemicals that can precede, follow or be mixed with the fracturing oil.

You need pay no premium for big units on small volume jobs. Halliburton's specially designed pumping and continuous proportioning equipment is sized to the job. That's another reason why you save with Sandoil fracturing.

Continuous proportioning at well site permits rigid control of sand ratios and fast, high horsepower pumps provide optimum controlled injection rates at desired pressures.

For big or small volume fracturing, Halliburton's Sandoil process can save you money... and increase production profitably. It will pay you to discuss it with your Halliburton representative. Call the local or district office or write the Halliburton Oil Well Cementing Company, Duncan, Oklahoma.

Ask for bulletin "Elements of Hydraulic Fracturing"

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Cottonwood Creek Field, Washakie County, Wyoming—A Carbonate Stratigraphic Trap

JOHN J. PERRY, Pan American Petroleum Corp., Casper, Wyo.

COTTONWOOD Creek field is perhaps the first major discovery in Wyoming drilled specifically as a stratigraphic trap prospect. At present, the field is 4 miles long and 2 miles wide with 5,000 acres proved productive by 28 Phosphoria wells. The southern and western limits of the field have not yet been defined.

During deposition of the Phosphoria west central Wyoming was the site of a large arcuate embayment on a shallow platform that sloped westward into the Cordilleran miogeosyncline. Throughout most of Phosphoria time the eastern margin of marine deposition fluctuated within the area of the present Big Horn basin. Cottonwood Creek field is located near the eastern edge of the final marine transgression of the Phosphoria sea. The facies change from marine dolomite to red shale and anhydrite provides the trap for oil accumulation. Development of porosity in the dolomite at Cotton wood Creek may be due to a reef.

The producing zone is oolitic, fossiliferous, stylolitic, fractured dolomite with pin-point to coarse vugular porosity. The thickness of dolomite in the producing wells ranges from 30 to 95 ft. while the net porous dolomite varies from a few feet to 74 ft.

Cottonwood Creek field is believed to be a volumetric reservoir with solution gas drive as the producing mechanism. The oil is 30.2° gravity with 2.7 per cent sulfur. The production for all wells in the field is 10,000 bbl. of oil per day.

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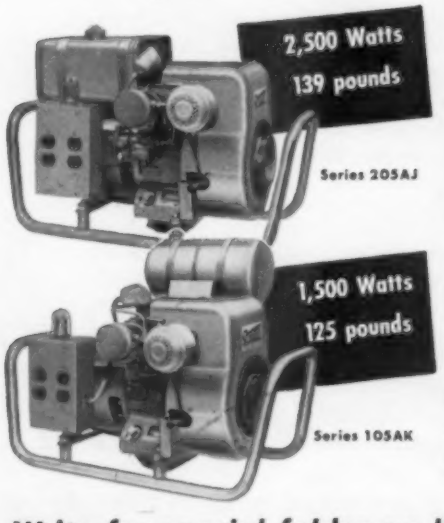

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LOUISIANA

NORTH LOUISIANA

Smackover Oil Strike Finaled in Monroe Gas Field

The most significant wildcat discovery of the year in North Louisiana is Olin Oil & Gas Corp. 1-J Olin Unit in 18-21n-3e, 3½ miles southwest of Haile in the western portion of Monroe gas field, Union Parish.

Olin completed the Smackover discovery flowing 280 bbl. of 40°-gravity oil daily on 12/64-in. choke from perforations at 8,999-9,003 ft. This Smackover strike is 24 miles east of Smackover production at Bernice field, western Union Parish. Monroe gas field itself produces from the Gas Rock at shallow depths.

Bernice Smackover Well Completed in Union

Another Smackover discovery put North Louisiana back into the exploratory scene last week. Union Producing Co. 1 Odom, 1 mile northwest of Bernice town and 4¼ miles northwest of Bernice field-Smackover, and 3¼ miles northeast of Bull Creek-Smackover field, flowed 304 bbl. of 54.5°-gravity oil and 975 M.c.f. of gas daily on 12/64-in. choke from perforations at 10,294-10,300 ft.

KANSAS

SOUTHWEST KANSAS

Big Flow Reported At Sparks Stepout

A 1½-mile south extension to Sparks pool in northern Morton County, extreme southwestern Kansas, flowed gas at the rate of 29,700 M.c.f. per day without fracturing. The Keyes sand-Pennsylvanian well is Rupp-Ferguson Oil Co.'s 1 Collingwood in C NE 15-31s-42w.

The gas is from perforations at 5,147-95 ft.

OKLAHOMA

SOUTHWEST OKLAHOMA

Deep Test No. 8 Staked at Knox

The eighth British-American Oil Producing Co. deep location has been staked in Knox field, Grady County. The latest addition to the growing ultra-

An authoritative report on the fabulous Oil Sands Deposits of Northern Alberta.

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TRAVELING PLUNGER ROD TYPE BOTTOM HOLD-DOWN PUMP STANDARD SIZE

Figs. 400P, 600P, 700P, 800P

Single or double, self-aligning, combination cup and plunger or all-metal traveling plunger type pumps made in four sizes: regular 1½", 1¾" oversize, 2" regular and 2½" oversize bore. These pumps seat in API seating device. In very sandy wells, or when tubing is out, we recommend our SAND HOUSING MECHANICAL SEATING SHOE, which prevents sanding in of pumps as sand can be pumped and the pump pulled at any time by our sand flushing arrangement.

TOP HOLD DOWN INSERT ROD PUMP

Standard Size, Figs. 400T, 500T

Self-aligning double plunger insert pumps. Made in three types: combination cup and single plunger; combination cup and double self-aligning type; and metal-to-metal double plunger self-aligning type. All are equipped with Regular or Extra Long Alloy Plungers, ground individually to fit the barrels, assuring longer life on both pump and surface equipment.

SELF-ALIGNING SAND SEALED-OFF PUMPS

Figs. 600-800-900

Inverted Combination Single or Double Plunger Self-Aligning Pumps can be equipped with a Sand Flush Valve which seals the Plunger off on top and cleans the barrel every pump stroke.

Sand is deposited into blind cage above the plunger and is discharged every stroke of the pump. The bottom of plunger is sealed to eliminate slippage. Easy on surface equipment. Lower lifting cost with Sealed-Off Pumps.

Can be run in any API seating device or use an adapter to fit the seating device preferred. We carry in stock at all times Special Heavy Duty Sand Housing Mechanical Seating Shoes which are very important to bad sand conditions—a place for sand to settle, so when pump is on down stroke, the bottom barrel bushing with a double spiral spray reaches into the sand housing, moving the sand out into the tubing.

SPECIAL HEAVY DUTY SEATING DEVICE

This special Combination Sand Housing and Seating Device is invaluable in bad sand conditions, especially where pump is sanding into the tubing. In extremely sandy wells the pump may be unseated occasionally to allow a small portion of tubing fluid to flush through the sand housing and return the accumulated sand to the well.

Pumps for all fields, depths and conditions. For further information write for complete catalog.

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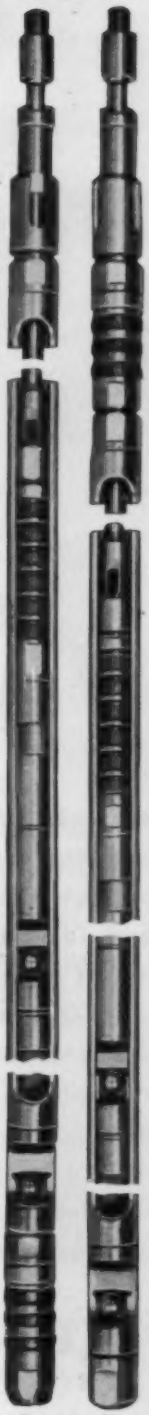

Fig. 400P 600P 700P 800P

Fig. 400T 500T

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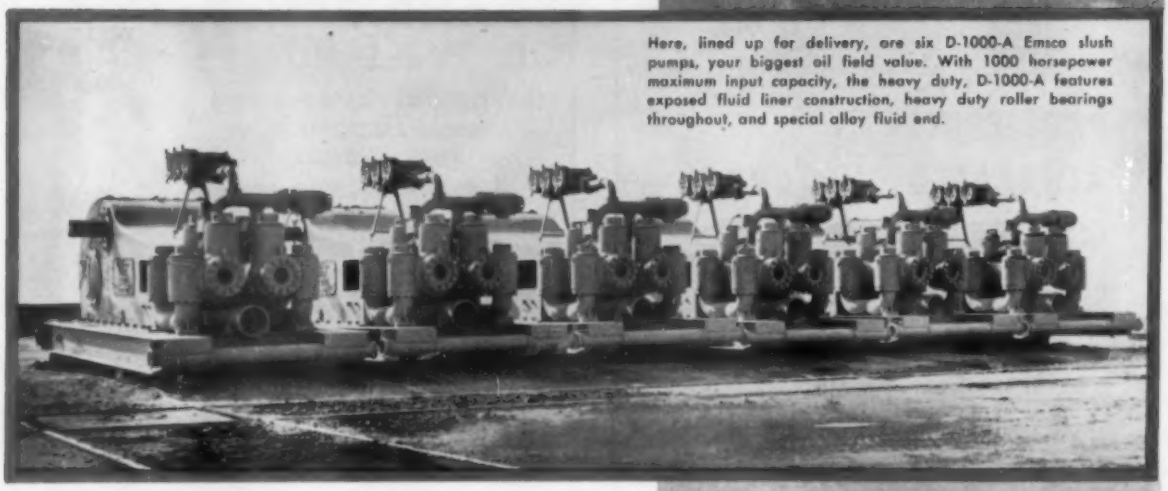

Here, lined up for delivery, are six D-1000-A Emsco slush pumps, your biggest oil field value. With 1000 horsepower maximum input capacity, the heavy duty, D-1000-A features exposed fluid liner construction, heavy duty roller bearings throughout, and special alloy fluid end.

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Designed and built for extra heavy-duty performance, the D-1000-A slush pump provides the high fluid pressures and volumes you need for deep hole jet drilling. The low weight high performance feature of this pump is made possible by Emsco's fabriform construction. Like all Emsco slush pumps, the D-1000-A is dependable, economical, and easy to maintain. Let your Mid-Continent representative show you how this Emsco pump performs on the deepest holes.

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deep play is the 1 Brickel (Edwards) in C SW NE 4-2n-5w. B.A. will take this one to 15,800 ft. in the Bromide-Ordovician sands.

Two deep wells in this area have broken Oklahoma producing-depth records. Four other wells are drilling, and Pan American Petroleum Corp. has one going on the southeast side of the deep field.

CALIFORNIA

Lyle Warner's new field discovery well near Prado Dam in Riverside County has been put on the pump. No production figures were immediately available but it appeared it would be good for 40-50 bbl. daily. This well, 1 G-G, puts Riverside on the state's list of oil producing counties. Production is from a Miocene interval at 3,460-3,613 ft. The wildcat recovered 3,000 ft. of 27-28°-gravity crude on a drill stem test. It is located in NW NW 20-3s-7w.

CANADA

QUEBEC

At 2 Bald Mountain on the Gaspe Peninsula, work of drilling the bridged formation at 6,600 ft. is temporarily halted due to motor failure and the arrival of parts from the United States.

At 1 North Shore, 1 2/10 miles south of Batiscan, after drilling 3 more feet to 2,197 ft., the gas increased and tested from 3,500,000 cu. ft. to 7,900,000 cu. ft. per day, and when closed in, registered the gage's capacity of 1,000 psi. within 30 minutes.

The well is being completed at this depth and rated capacity and the drill rig moved 1,320 ft. east to drill 4 North Shore.

At 2 North Shore, 2 miles south of Berthier, drilling is being resumed below 1,360 ft.

At 3 North Shore, 2 miles south of Portneuf, light green oil was noted on the cores from 1,200 ft. to bottom at 1,290 ft., accompanied by gas blows, and the well is being readied for testing.

At its Gaspe Peninsula oil concessions, Associated Developments, Ltd., expects to start drilling after the spring thaw.

At 1 Tar Point, on the Gaspe Peninsula, drilling and testing are scheduled for the summer.

At Miller Copper Mines, Ltd., diamond drilling is expected to be resumed in the spring.

TEXAS

WEST TEXAS

Motley County Gains Its First Oil Production

Pan American Petroleum Corp. has completed its 1 Brandon as the first oil well for Motley County. Initial potential, on the pump, was 232 bbl. of 42.6° oil a day from pay at 4,150-70 ft. The pay section has been identified as Wolfcamp, or Permo-Pennsylvanian.

Location of the discovery, 1 Fred E. Brandon, is in Section 7, Block O-4, WTRR Survey, 6 miles east of the town of Roaring Springs. Pan American has full interest in the well and a 21,000-acre block in the area. The well is on a portion of the 812,000-acre Matador Ranch, most of which has been sold. Half of the mineral rights are said to be held by Toreador Royalty Co.

Geologically, the well is along the Matador uplift, an east-west feature

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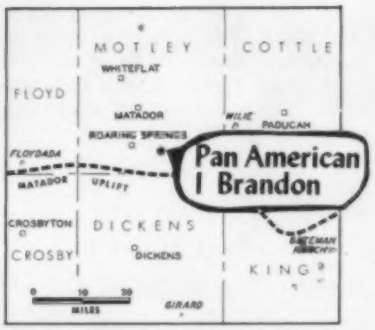
separating Midland basin and eastern shelf from the Plainview, or Palo Duro basin. Both production and exploration along the arch has been light. Wilie field, about 16 miles northeast is nearest production, was a 267 bbl. from two wells.

Floydada field, nearly 30 miles west in Floyd County, reported 286 bbl. oil production in December, from one well. Pay is the Pennsylvanian.

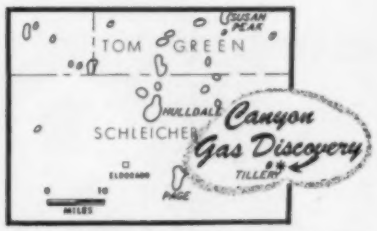
Schleicher County . . . Sinclair Oil & Gas Co. 5 Powell has been completed as a gas discovery, flowing from two sections of the Canyon.



Pan American Petroleum Corp. 1 Brandon has been completed as a Wolfcamp discovery.

On final test the well gaged 7,000 M.c.f. of gas a day from upper Canyon perforations at 3,391-3,401 ft., and 4,550 M.c.f. from lower Canyon perforations at 3,872-82 ft. Total depth is 4,780 ft.

Location is 25 miles east of Eldorado, in Tract A, R. Douglas Survey 1504½. Sinclair is said to hold several thousand acres in the area.



Sinclair Oil & Gas Co. has opened a new gas pool east of Tillery field in southeastern Schleicher County.

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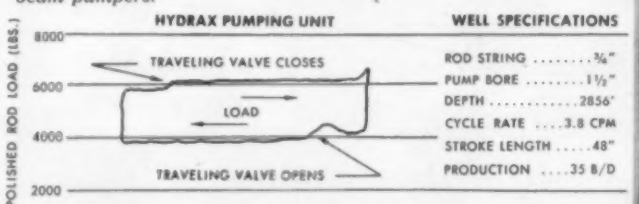
Axelson's 4-ft. Hydrax Jr., a completely hydraulic pumping unit for low-production and stripper wells, has a polished rod capacity of 8,000 lbs. Performs slowly for greater volumetric efficiency. Smooth operation and cushioned reversals assure longer sucker rod life, more service from subsurface pumps.

The Hydrax Jr. mounts directly on the production tee. No foundation or substructures. Can be installed in less than three hours; moved anywhere in the field with a light A-frame truck.

Controls are at production tee level. No ladders to climb for servicing, no special tools required. Hydrax dealers stock all parts.

Dynagraph card shows Hydrax Jr.'s smooth performance. Note its constant load characteristic compared to uneven loads common to beam pumpers.



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EAST TEXAS

Two New Tests Set for Henderson Salt Dome

Two exploratory wells have been set for the LaRue salt dome area in Henderson County. These are:

W. C. Perryman and L. P. LaRue, Athens, 1 Mollie Wagers. Location is 12 miles east and slightly north of Athens, on a 95-acre lease in the Aaron York Survey, A-847. Acreage was farmed out by Magnolia Petroleum Co. Projected depth is 5,000 ft.

The other test is C. L. Norsworthy, Jr. 1-A J. S. Abercrombie. Location is on a 205-acre tract in the Simon Boon Survey, 3 miles north of LaRue. Projected depth was 4,800 ft. An Iran Drilling Co. rig was spudding in at last report.

Successful Wildcats

CALIFORNIA

Fresno County: Carr, Wrath & Payne 21A-7 McCarthy et al, NW NW 7-17s-19e, 100 BOPD, 33°-gravity crude, 7/64-in. choke, perfs. 4 holes at 6,763 ft., 2-in. tubing hung at 6,765 ft., packer at 6,700 ft. TD 8,029 ft. (New Miocene pool discovery in northwest section of Riverdale field. Operator has 3 zones with only the deepest zone on production.)

NORTHWEST NEW MEXICO

Rio Arriba County: Harrell Budd 1 Dunn, C SW SW 10-23n-7w. IPP 74 BOPD, Gallup sand discovery, new field. TD 5,896 ft. Gallup.

San Juan County: Gulf Oil Corp. 1 Blackrock-Federal, C NW NW 20-26n-11w. IP 705 M.c.f. of gas per day, Gallup sand discovery, new field. TD 6,302 ft. Gallup.

El Paso Natural Gas Co. 1 Sullivan "F," NW SE SW 32-27n-12w. IPF 525 BOPD, Gallup discovery, new field. TD 5,065 ft. Gallup.

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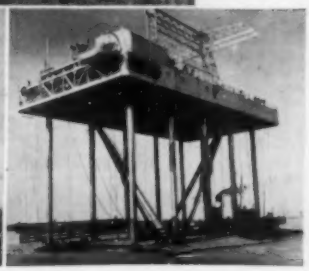

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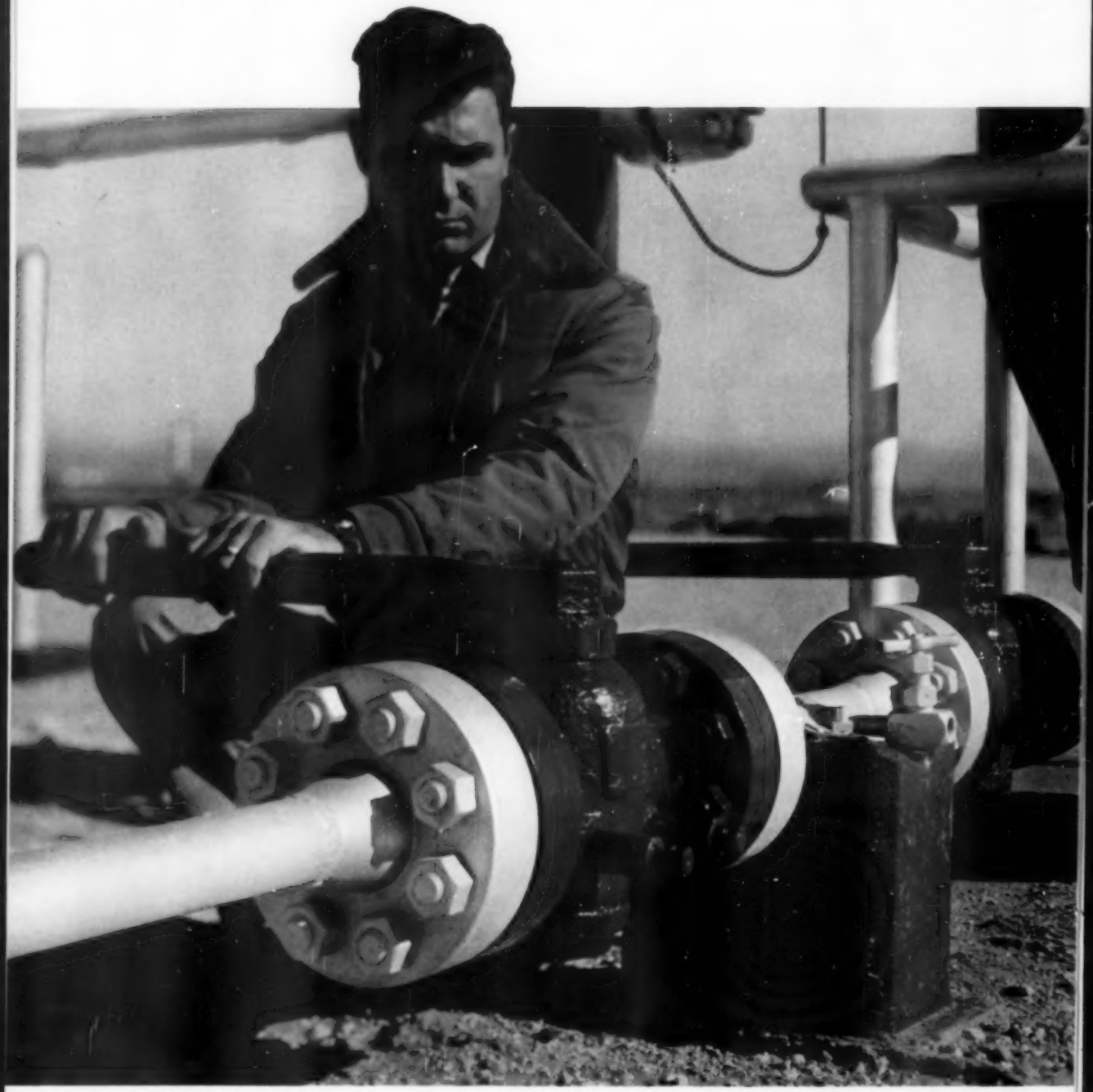
How these two brought lower valve costs to a West



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MISSION PLUG VALVES
Texas pressure maintenance plant

At the left, you see two of the three Mission Plug Valves that pointed the way to lower overall maintenance costs to the operators of a West Texas Plant. They proved to a skeptical management that Mission Valves *actually do cost less* because they last longer and require less maintenance.

These three valves were the only Mission Valves installed when the plant was built early in 1950. The two valves shown are installed on a scrubber blowdown near an injection well and the third was in the injection line just before the scrubber.

All three valves handle wet sour gas at 4000 psi. All have been in continuous service since 1950 and all three still work perfectly. They are among a very few of the original valves still operating.

Mission Plug Valves were originally accepted simply because no other valves were available. Their performance has been so outstanding that they are now among the first chosen for service at this plant.

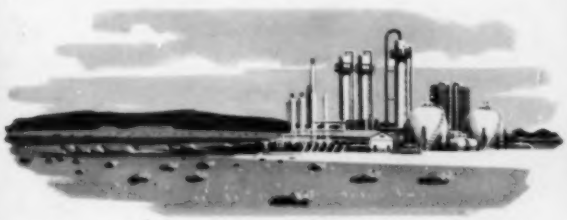
There are many reasons for the long life and dependability of Mission Valves, but the most important is the *Automatic-lubrication system* — exclusive with Mission in plug valves.

Without this system, a small leak could start and serious valve damage could occur before an attendant became aware that the valve was leaking.

But the automatic lubrication system serves as an untiring sentinel — automatically stopping leaks *before* they start — and before valve damage can take place.

Why don't you profit from this experience and install Mission *Automatic-Lubricated* Plug Valves on your wells or in your plants. You too, will discover a new low in valve costs and a new high in dependability.

Mission Plug Valves, like other Mission Products, are available through supply stores everywhere.



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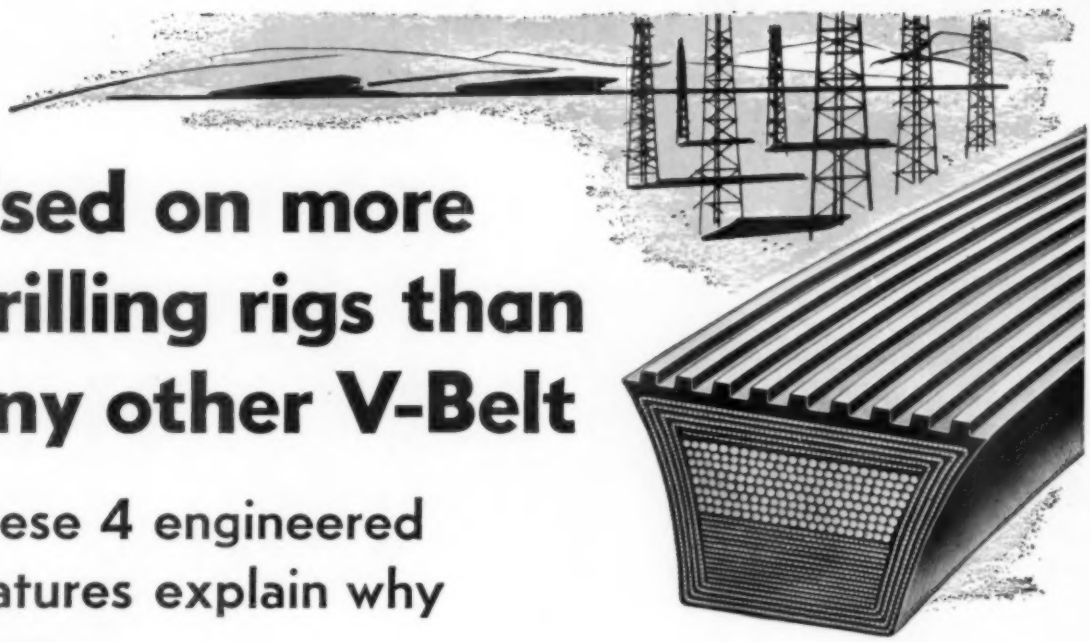
This six-inch Mission Plug Valve is one of three installed on a bypass manifold handling sweet gas. Other Mission Valves are installed at many locations in the plant.



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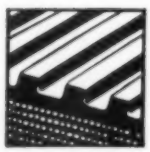
2. Concave Sidewalls (U.S. Pat. No. 1813698). Provide sure pulling power, less wear, longer V-belt life, because as belt bends around the sheave, concave sides fill out . . . become straight . . . fit sheave grooves evenly (Fig. 1). Straight-sided belts bulge at the sides when bent. Uneven contact (Fig. 2) causes uneven wear, shorter belt life.



3. Stabilizing Ribbed Top (U.S. Pat. No. 2548135). Dampens vibration . . . protects top of belt against damage . . . keeps belt running smoothly over idler-equipped mud pump drives, with no side whip.

4. Flex-Weave Cover (U.S. Pat. No. 2519590). Insures greater flexibility with far less stress on fabric. Wears longer . . . increases belt life . . . lowers belt costs . . . makes more power available to driven machine.

In oil fields around the world, drillers minimize down time and reduce belt replacement costs by *standardizing* on Rib-Tops—the V-belts *specifically developed* for mud pump drives. Yet they *pay no more* for Rib-Tops than for ordinary belts of comparable ratings. Both Standard and Super Rib-Top V-Belts are available from your supply house.

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. . . Engineer Turns Oil Trader

A VETERAN refinery engineer at Shreveport, La., is one man who's really enjoying a new job. And why shouldn't he? It's a free-spending deal, requiring the talents of a shrewd horse trader. Nearly everyone gets a thrill out of a good trade.

This engineer turned oil trader is A. J. Ferguson. His new job is chief crude-oil buyer for Esso Standard Oil Co. On his say-so, Esso literally spends millions of dollars weekly for crude to supply its refineries at Baton Rouge and elsewhere.

The Baton Rouge plant alone requires more than a million dollars worth of crude oil a day when it is operating at its capacity of 352,000 bbl. daily.

Ferguson inherited a tough and complicated job. Many in the oil industry, even, are unaware of the important role played by the crude-oil buyer. The profit success of a refinery often depends on his deals. He must buy the right type of crude for his particular plant, get it at a fair price, and get it delivered. Sometimes to do this requires a series of complicated trades and sales involving crude in many far spots of the country.

Ferguson's task was even tougher when he took over last December. He succeeded one of the top oil buyers in the country at the Esso job. Ferguson moved up when C. H. Whitman retired after nearly 42 years' service with Esso and 19 years in the crude-purchasing post. Ferguson had been Whitman's assistant for little more than a year.

A refinery man . . . Ferguson's job may seem a peculiar spot for a trained engineer.

But Ferguson has worked his way through a variety of refinery tasks, and Esso apparently felt a man of his broad refinery know-how was needed to fill the important crude-buying job.

Ferguson is a native of New Orleans. He attended Loyola University there for 3 years before enrolling at Louisiana State University at Baton Rouge. He was graduated with a degree in mechanical engineering in 1938 and immediately joined Esso at the Baton Rouge plant.

The fledgling engineer's first job was in the equipment inspection department. He served successively as a process engineer, as the refinery's safety supervisor, as assistant chief of maintenance and construction, and as assistant mechanical engineer.

A. J. FERGUSON

. . . he spends millions weekly for Esso.

In 1951 Ferguson's experience began to broaden with the company. He was named assistant division purchasing agent and the next year became assistant traffic manager. He then served as head of the yield and cost department until September 1954, when he was appointed assistant chief of the technical division. Ferguson worked at that job until he became assistant to Whitman in April 1955.

Ferguson has held his new job only a few months now. But his friends feel this likely won't be his last move. Tougher jobs are always opening up for men with his broad experience in nearly every phase of running a refinery.

Wide interests . . . Ferguson's activities aren't centered on his job. He has a wide variety of outside interests.

He is a family man. He is married to the former Patsi Wells of Baton Rouge, and the couple has three children, a son and two daughters.

Ferguson is a member of the Rotary Club of Shreveport, the Shreveport Club, and the Shreveport Petroleum Club. He also is a member of the Louisiana Engineering Society, the American Petroleum Institute, and the Mississippi - Alabama and Louisiana-Arkansas divisions of the Mid-Continent Oil and Gas Association.

His interest in civic affairs is centered in membership with the Public Affairs Research Council, which he serves as a board member.

Personals

B. C. Bond has opened offices in Meeker, Colo., as a consulting geologist.

E. R. Wolcott, geologist with Humble Oil & Refining Co., has been transferred to Wichita Falls from Winters, Tex.

A. L. Rhodes, formerly division superintendent in Tulsa for General American Oil Co. of Texas, has been named general superintendent of drilling and production for Livingston Oil Co., Tulsa.

James F. Grutsch has been appointed group leader by Standard Oil Co. (Ind.) in the company's heavy oils, asphalt, and ammonia technical service division, research department, Whiting, Ind. Grutsch has been with Indiana Standard since 1952.

J. P. D. Hull, managing editor of the American Association of Petroleum Geologists, has been awarded the Sid-

J. P. D. HULL

J. V. HOWELL

ney Powers medal, highest honor given by A.A.P.G. Hull was chief geologist for Louisiana Oil Refining Corp. when he became A.A.P.G. business manager in 1926. He was made an honorary member of the association in 1951 and has been managing editor since 1952. **J. V. Howell,** Tulsa geological consultant and one of the founders of A.A.P.G., has been made an honorary member of the association. Howell was with the old Marland Oil Co. before becoming a consultant in 1929.

T. H. Milliken, section chief in catalyst research and development for Houdry Process Corp., has been named head of the company's new contract research group. **Dr. Heinz Heinemann,** section chief in process research, has been appointed section chief of contract research. **Dr. Harold Shalit** will succeed Heinemann in process research. **J. J. Donovan,** project director in catalyst research, has been transferred to contract research in the same capacity. **E. B. Cornelius** will replace Donovan in catalyst research.

Personals

James Laubach, geologist with Continental Oil Co., has been transferred to Shreveport from Jackson, Miss.

W. J. SPARKS

Dr. William J. Sparks, director of Esso Research & Engineering Co.'s chemicals-research division, has been appointed scientific advisor, a new position. He will be responsible for surveys of research activity and recommendations of research projects. Sparks is the inventor, with **Robert M. Thomas,** of butyl synthetic rubber. He has been with Esso since 1936.

J. G. Glenney, The Texas Co.'s district production superintendent at Pampa, Tex., has been transferred to Snyder, Tex., as unit engineer of the Cogdell unitization project. **R. A. Barton, Jr.,** petroleum engineer for the company at Wichita Falls, Tex., will succeed Glenney at Pampa.

John B. Nunn, manager of Ashland Oil & Refining Co.'s Midland, Tex., office, has resigned to become an independent operator in Evansville, Ind.

Edmund F. Baxter, Jr., has joined Esso Research & Engineering Co. in the Linden, N. J., products-research division.

Duncan V. Patty has been appointed manager and **James B. Henry,** chief reservoir engineer, in Anderson-Prichard Oil Corp.'s new economics and evaluation department.

J. William Schmotzer, regional geologist with Arkansas Fuel Oil Corp., has been promoted to assistant chief geologist. Schmotzer has been with Arkansas Fuel Oil since 1930, and has been regional geologist since 1955.

J. C. Farris, district engineer with Pan American Petroleum Corp. in Longview, Tex., has been appointed field superintendent and transferred to Greggton, Tex. Farris succeeds **C. B. Campbell,** who has been transferred to Brownfield, Tex., as field superintendent. **F. L. Nabors,** senior petroleum engineer in Tulsa, will replace Farris as district engineer in Longview.

A.P.I. Southern Production District Elects

Ben F. Carter, seated at right, Union Producing Co., Shreveport, has been named chairman of the American Petroleum Institute Division of Production, southern district. He succeeds John M. Payne, seated at left, Shell Oil Co., Houston. Payne has been appointed chairman of the district advisory committee. Other officers are, standing, left to right, Gore Kemp, B. M. Davis Tool & Machine Co., Kilgore, Tex., vice chairman for East Texas; W. D. Taylor, Schlumberger Well Surveying Corp., Victoria, Tex., vice chairman for South Central Texas; W. W. Bynum, Hycalog, Inc., Shreveport, vice chairman for Ark.-La.-Tex. area; and J. A. Williams, McCullough Tool Co., Houston, secretary-treasurer. Not pictured are A. T. Pall, The Texas Co., Alice, Tex., vice chairman for Southwest Texas; Fran H. Yeargers, Schlumberger Well Surveying Corp., Lafayette, La., vice chairman for Southwest Louisiana; Austin Moseley, Southland Drilling Co., San Antonio, Tex., vice chairman for the Balcones area; Jim Langston, Humble Oil & Refining Co., Franklin, La., vice chairman for South Louisiana; H. J. Brady, McAllen, Tex., consultant, vice chairman for the Rio Grande Valley; and W. O. Bartle, Brewster & Bartle Drilling Co., Houston, vice chairman for the Texas Gulf Coast.

W. W. LOWE

W. W. Lowe, vice president of Cities Service Petroleum, Inc., and president of Wolverine Pipe Line Co., has been elected a director of Cities Service Co. Lowe is a director of Cities Service Refining Corp. and Cities Service Research & Development Co. He has been with Cities Service since 1912 and has been vice president and a director of Cities Service Petroleum since 1946.

Julian A. Rogers, head of Grace Chemical Co.'s ammonia department in Memphis, Tenn., has been named head of the manufacturing department, polymer chemicals division, at W. R. Grace & Co.'s Baton Rouge, La., polyethylene plant.

Lyle C. Pratt, Bernard E. Woods, Russell S. Pease, and **Louis G. Fuller** have been named shift foremen of the crude-cracking areas at Tidewater Oil Co.'s new Delaware City refinery. **William F. Limber, Edward F. Naus, Earl J. Borde,** and **John J. Scott** have been appointed shift foremen of the alkylation-polymerization-reforming-desulfurizing areas of the refinery.

R. N. Harding, deputy managing director of Caltex Pacific Co. of Indonesia, has been named managing director. He succeeds **A. B. Brown,** who will return to Standard Oil Co. of California after 2 years with Caltex Pacific Harding has been with The Texas Co. since 1937. Caltex Pacific is owned jointly by Standard of California and The Texas Co.

Alan Abeel, group head in Esso Standard Oil Co.'s Bayway refinery supply and distribution department, has been appointed head of the New York supply department's program section and transferred to New York from Linden, N. J. **Robert Wilson,** senior engineer at the Bayway refinery, will succeed Abeel as group head in supply and distribution.

Dr. Robert E. Brouillard, assistant manager of research and development at General Aniline & Film Corp.'s Linden, N. J., plant, has been appointed assistant manager of the pigment division. Brouillard joined General Aniline in 1951. Before that time he was with American Cyanamid Co. **Emil A. Wich** has been named manager of the company's pigment technical department, dyestuff and chemical division. Wich has been with General Aniline since 1939.

Kennedy Heads W.P.R.A.

Harry J. Kennedy, Houston, Continental Oil Co.'s vice president of marketing, has been elected president of the Western Petroleum Refiners Association. Kennedy succeeds Reid Brazell, president of Leonard Refineries, Alma, Mich. Elected vice presidents of W.P.R.A. were Floyd L. Martin, Suntide Refining Co.; Rex S. Blazer, Ashland Oil & Refining Co.; W. J. Carthaus, Great Northern Oil Co.; Walter Famariss, Famariss Oil Co.; and J. A. Vickers, Vickers Petroleum Co. New directors of the association are C. R. Brown, Tidewater Oil Co.; W. T. Cravens, Cities Service Oil Co.; and C. D. Tate, Phillips Petroleum Co.

John H. Atwood, drilling engineer with Warren - Bradshaw Exploration Co., has joined Sohio Petroleum Co. in New Orleans where he will supervise offshore drilling and production. Atwood was drilling and production engineer for Sohio in Pauls Valley, Okla., before joining Warren - Bradshaw last year.

L. B. (Preach) Meaders, president of Halliburton Oil Well Cementing Co., has been elected chairman of the national board of regents of Nomads. Meaders is a member of the Dallas-Fort Worth chapter of Nomads. A graduate of Harvard Advanced Management program, he has been with Halliburton since 1928.

John Lewis, geologist with Skelly Oil Co., has been transferred to Wichita from Billings, Mont. **Paul E. Randolph,** formerly with Colorado Exploration Co. in Casper, Wyo., and **Walter H. Martz,** formerly with Carter & Martz in Wichita, have both joined Skelly as geologists in Wichita.

Kenneth W. Paul, geologist with Shell Oil Co., has joined H. Zinder & Associates, Inc., in Houston as geological engineer.

J. B. Washburn has been appointed drilling superintendent for Hose-Austin Drilling Co.

Guy C. Ellison, senior geologist with Sunray Mid - Continent Oil Co. in Shreveport, has been transferred to the Lafayette, La., district office.

W. H. Hooper, retired technical engineer in Phillips Petroleum Co.'s fuel-oil and lubricating-oil departments, has been elected vice president and a director of Consolidated Fuel Oil Co., Inc., of Kansas City.

K. W. Kendrick, Los Angeles region manager of wholesale sales for Standard Oil Co. of California, has been appointed southern California region vice president of Standard Oil Co. of California, Western Operations, Inc.

George B. Jenkinson, retired unitization manager of Pan American Petroleum Corp., has opened offices in Tulsa as an independent oil operator and consultant. Jenkinson joined Midwest Refining Co. in 1914. Midwest was later taken over by Pan American, then Stanolind Oil & Gas Co. Jenkinson was assistant manager of foreign exploration for Pan American before becoming unitization manager in 1950.

Willis G. Violette, president of Standard Oil Co. (Ky.), has been elected chairman of the board. He will continue as chief executive officer and chairman of the executive committee. **William C. Smith,** a director of the company, will succeed Violette as president.

K. C. Heald, Fort Worth; **R. O. Canon,** Odessa, Tex.; **Benjamin L. Bird,** Fort Worth; and **Blanche Noyes,** New York, have been elected directors of Dixilyn Drilling Corp., Odessa, Tex. Heald, now a consultant, was a vice president and director of Gulf Oil Corp. until 1953. Canon, Odessa independent operator, is president and a director of the Petroleum Marketers Association of Texas. Bird is a partner in the law firm of Weeks, Bird, Canon, & Appleman; and Noyes, a partner in the investment and banking firm of Hemphill, Noyes & Co.

Personals

Ed Lewis, geologist at Mount Pleasant, Mich., with Gulf Oil Corp., has been transferred to Oklahoma City.

F. W. O'MALLEY

F. Ward O'Malley has been appointed manager of exploration in Ankara, Turkey, for Tidewater Oil Co. A graduate of Colorado School of Mines and Stanford University, O'Malley was formerly staff geologist with Continental Oil Co. in Houston. O'Malley joined Tidewater recently after having been with Continental since 1949.

R. H. Christman, contracting administrator for Service Pipe Line Co., has been promoted to civil engineer. He succeeds **K. N. Bradley,** recently promoted to senior engineer. **Fred W. Zilm,** welding technician, will replace Christman as contracting administrator.

John L. Loftis, Jr., Humble Oil & Refining Co.'s division geologist at Midland Tex., has been appointed assistant chief geologist and transferred to Houston. **R. W. Bybee,** assistant division geologist at Roswell, N. M., has been transferred to Midland as division geologist replacing Loftis. **W. S. Launcey,** assistant division geologist in Houston, has been transferred to Roswell in the same capacity.

DEATHS

Amour Loriaux, Sr., 71, Bartlesville, Okla., independent operator, died March 26 in Bartlesville after a heart attack.

James A. Clark, 67, partner in Gardner, Huff & Clark, Seminole, Okla., drilling company, and secretary-treasurer of Luttrell Oil Co., died March 23 in Tulsa.

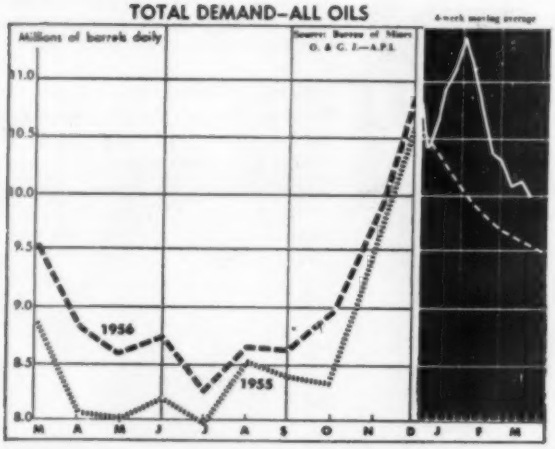
Walter C. (Pat) Athon, 68, retired Ohio Oil Co. pipeline division superintendent at Cody, Wyo., died recently. Athon had been Cody superintendent 37 years before his retirement 3 years ago.

William Calder, 61, mechanical superintendent of DX-Sunray Oil Co.'s Tulsa refinery, died March 27 in Tulsa. Calder joined Cosden Oil Co., one of DX-Sunray's forerunners, in 1919.

Latest Figures . . . Industry Trends

A QUICK LOOK AT THE HIGHLIGHTS

	LATEST WEEK	Change from WEEK AGO		Change from YEAR AGO	
Production	7,817,475	UP	27,600	UP	534,664
Crude stocks	251,921,000	DOWN	72,000	DOWN	4,745,000
Completions	1,166	UP	16	UP	179
Refinery runs	7,976,000	DOWN	122,000	UP	6,000
Gasoline stocks	205,521,000	DOWN	68,000	UP	8,720,000
Kerosine stocks	19,978,000	UP	277,000	UP	2,268,000
Distillate stocks	77,603,000	DOWN	1,996,000	UP	11,691,000
Residual stocks	36,886,000	UP	603,000	UP	2,839,000
Four-product stocks	339,988,000	DOWN	1,184,000	UP	25,518,000



What Happened to Crude Stocks? Is a Gasoline Market Break Brewing?

CRUDE-STOCK reports to the Bureau of Mines in the first half of March showed decreases at a time when other data seemed to indicate increases.

For the week ended March 8, current reports of crude production placed the average at 7,800,000 bbl. daily. The bureau's crude-stock report for the same week showed a net increase in stocks of domestic crude of 239,000 bbl. daily. If 239,000 bbl. daily came out of storage, total domestic crude supply for the week was 8,039,000 bbl. daily.

On the demand side, refinery runs of domestic crude amounted to 7,246,000 bbl. daily, according to the A.P.I. refinery report. The Office of Oil and Gas in the Department of Interior reported crude shipments to Europe averaging 166,000 bbl. daily for the week ended March 6. Other crude exports, transfers, and losses were estimated at 80,000 bbl. daily for 7,492,000 bbl. daily total demand.

This difference of 547,000 bbl. daily between supply and demand is unaccounted for and is too large to be due to errors in production or refinery runs. Stocks probably increased about 250,000 bbl. daily during the week.

The second week of March was similar to the first, but the unexplained crude dropped to about a million barrels for the week.

How to break a gasoline market . . . Each spring for the past several years some suppliers have been taking lessons on how to break the gasoline market. Here's the recipe they usually follow.

Start with high gasoline inventories at the end of the gasoline season. Continue high yields of gasoline during the winter months. Just before the gasoline season starts in the spring, take a look at gasoline stocks and decide that some gasoline will have to move before the end of March.

Call on all unbranded jobbers and try to sell at the normal price. In Group 3 area, that would be 12.50 cents a gallon at the refinery. When you don't get a single order, start back over the list offering 0.5 cent off. This doesn't get you more than a smile from the jobber. You work the entire list over again with an offer of 0.75 cent off. You move two truckloads out of pipeline terminals.

If you are a Group 3 supplier, you could have skipped all of the selling program up to this point because you would know that you can't sell much spot gasoline at 0.75 cent off.

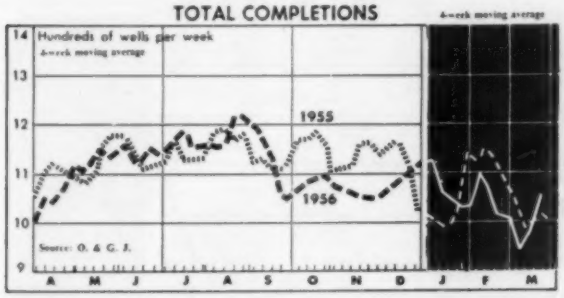
If you don't want your branded jobbers to know you need to move some gasoline at reduced prices, you may be able to get a reseller to handle the surplus. He may need 1.25 cents off since he may have to cut to 1.00 cent off to get volume through large jobbers.

You now have mixed all of the ingredients. A little heat generated when a competitor loses an account is all that is needed to start the chemical process that will end with a general lowering of gasoline prices.

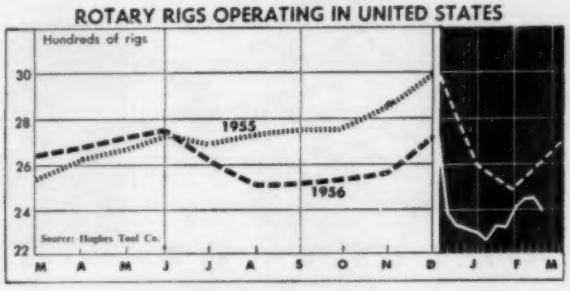
The competitor cuts prices to his jobber. The private-brand jobber cuts prices to his dealers. His dealers cut prices and take customers from stations selling branded gasoline. If branded-gasoline suppliers lose too much business, they cut tank-wagon prices and the entire gasoline schedule is dropped to a lower level.

Can you eat that cake and like it?

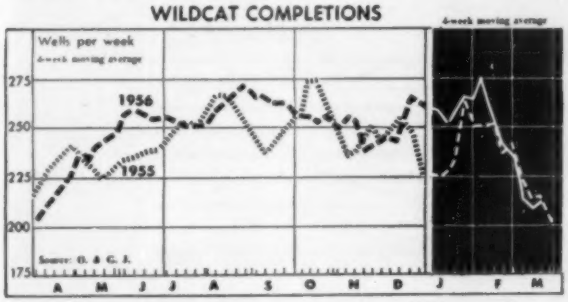
TOTAL COMPLETIONS



ROTARY RIGS OPERATING IN UNITED STATES



WILDCAT COMPLETIONS



ACTIVE ROTARY RIGS*

Area—	3-25-57	3-18-57	3-26-56
North Central and East	79	88	85
Southeast	34	35	31
Okla., Kans., Ark., Mo.	420	435	505
Louisiana	431	427	437
North and East Texas-Panhandle	397	425	446
Gulf and South Texas	220	229	281
West Texas-New Mexico	527	514	523
Rocky Mountain	191	200	211
Pacific Coast	97	97	124
Total United States	2,396	2,450	2,643
Western Canada	225	243	190

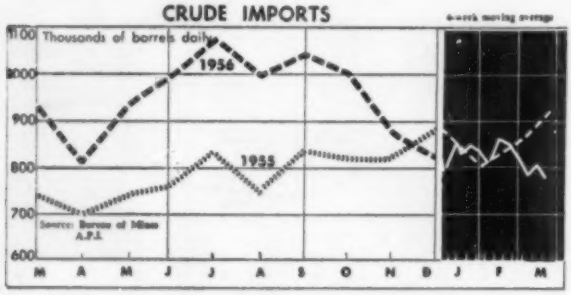
*Hughes Tool Co.

WEEKLY WELL COMPLETIONS . . . WEEK ENDED MARCH 23, 1957

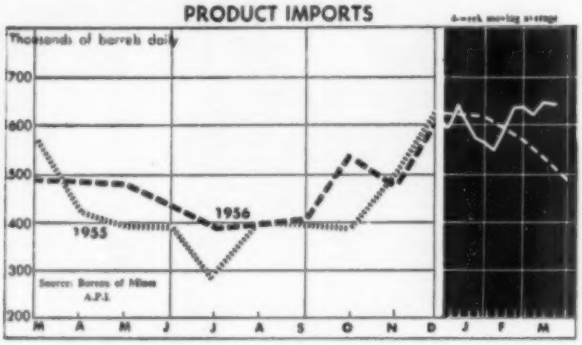
	Total of all wells					Cum.		Wildcat completions and discoveries					Cumulative total, 1957				
	Comp.	Oil	Gas	Dry	Footage	1957	1956	Oil	Dist.	Gas	Dry	Total	Oil	Dist.	Gas	Dry	Total
Ala.-Ga.-Fla.‡	5	2	0	3	41,726	20	22	0	0	0	3	3	0	0	0	8	8
Arkansas	12	9	0	3	30,955	239	175	0	0	0	1	1	5	0	1	29	35
California	37	25	2	10	168,144	474	478	2	0	0	8	10	10	0	2	113	125
Colorado	11	1	0	10	56,057	243	261	0	0	0	8	8	7	0	3	154	164
Illinois	34	11	1	22	73,322	536	764	0	0	0	10	10	7	0	1	123	131
Indiana	9	3	0	6	11,511	143	147	0	0	0	2	2	3	0	0	25	28
Kansas	92	46	11	35	340,424	1,001	1,111	2	0	2	13	17	31	0	7	134	172
Kentucky	13	5	0	8	20,060	327	389	1	0	0	2	3	9	0	1	63	73
Louisiana	90	51	12	27	702,177	884	899	1	2	1	6	10	18	9	20	95	142
North	30	19	5	6	99,016	335	329	0	0	0	1	1	2	0	2	33	37
South	44	26	4	14	452,841	396	457	1	1	1	4	7	9	8	14	55	86
Offshore	16	6	3	7	150,320	153	113	0	1	0	1	2	7	1	4	7	19
Michigan	6	2	0	4	15,199	89	119	0	0	0	3	3	3	0	0	36	39
Mississippi	7	3	0	4	43,858	76	99	1	0	0	2	3	5	0	0	31	36
Montana	4	2	0	2	30,324	68	90	0	0	0	2	2	2	0	0	22	24
Nebraska	13	6	0	7	76,410	174	203	0	0	0	6	6	8	0	0	89	97
New Mexico	33	19	10	4	151,191	448	423	4	0	1	2	7	18	1	5	47	71
Northwest	14	3	10	1	63,191	164	144	2	0	1	1	4	8	1	4	15	28
Southeast	19	16	0	3	88,000	284	279	2	0	0	1	3	10	0	1	32	43
North Dakota	4	2	0	2	24,422	75	50	0	0	0	2	2	4	0	0	26	30
Ohio	20	11	2	§7	57,941	234	241	0	0	0	0	0	0	0	0	3	3
Oklahoma	104	62	2	¶40	359,913	1,538	2,005	1	1	0	5	7	28	5	1	139	173
Pennsylvania-New York†	258	93	70	‖95	564,976	*412	155	0	0	0	1	1	0	0	8	16	24
Texas	386	232	12	142	1,680,955	4,995	4,822	13	0	2	80	95	156	9	54	1,168	1,387
Southwest (1 & 4)	54	31	2	21	229,553	573	733	2	0	1	14	17	21	2	16	182	221
Gulf Coast (2 & 3)	36	17	3	16	266,798	597	617	0	0	1	11	12	14	4	29	167	214
East (5 & 6)	20	8	6	6	121,844	284	256	0	0	0	6	6	4	0	1	82	87
N. Central (7-B & 9)	144	86	0	58	408,270	1,822	1,617	10	0	0	26	36	80	0	3	516	599
West (7-C & 8)	132	90	1	41	654,490	1,413	1,321	1	0	0	23	24	35	0	4	201	240
Panhandle (10)	0	0	0	0	0	306	278	0	0	0	0	0	2	3	1	20	26
Utah	6	1	0	5	27,479	34	19	0	0	0	5	5	3	0	0	18	21
West Virginia	10	1	8	1	24,354	160	166	0	0	0	0	0	0	0	7	2	9
Wyoming	12	5	0	7	55,079	193	179	1	0	0	3	4	9	0	2	59	70
Miscellaneous	0	0	0	0	0	19	46	0	0	0	0	0	0	0	1	12	13
Total United States	**1,166**	592	130	444	4,556,477	*12,382	12,863	26	3	6	164	**199**	326	24	113	2,412	*2,875
Total previous week	1,150	609	72	469	4,544,055	.....	.....	18	3	9	192	222	300	21	107	2,247	2,675
Total Mar. 24, 1956	987	603	58	326	4,018,211	.....	.....	39	1	5	160	205	390	34	84	2,354	2,862
Cumulative 1957*	12,382	6,607	945	4,830	50,608,920	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Western Canada	73	41	1	31	206,864	592	518	4	0	0	27	31	12	0	13	144	169

*Revised. †Incl. first 3 months. Pa. 258 wells. ‡Fla. 1, 7,755 ft. Service wells included: §2, ¶5, ‖84.

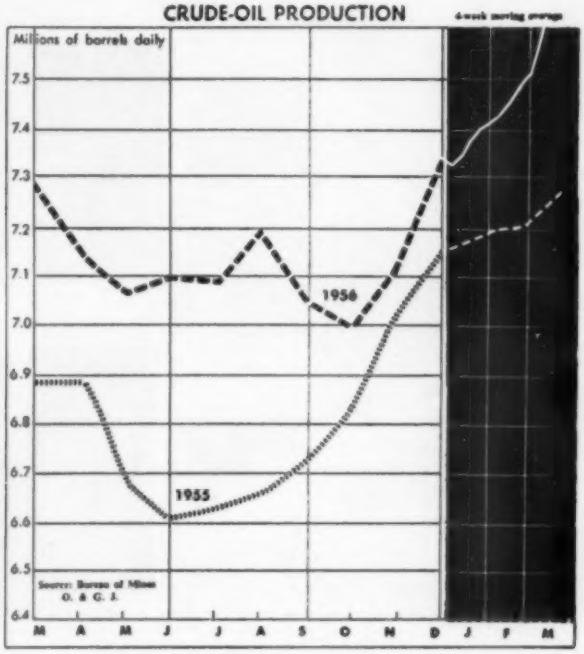
CRUDE IMPORTS



PRODUCT IMPORTS



CRUDE-OIL PRODUCTION

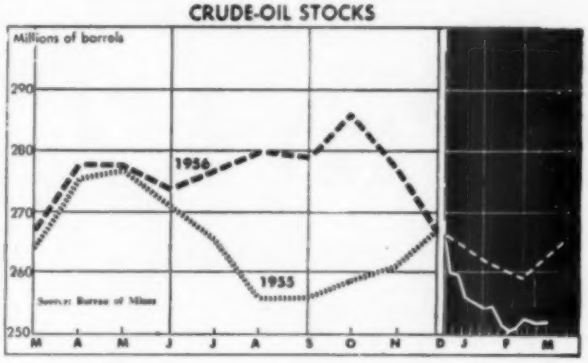


DAILY AVERAGE PRODUCTION FOR WEEK

	March 23, 1957			Mar. 16
	Crude oil	Lease condensate	Total	total
Alabama	11,750	.....	11,750	11,700
Arkansas	83,750	350	84,100	83,750
California	939,600	.....	939,600	938,400
Colorado	160,100	.....	160,100	158,600
Eastern	51,400	.....	51,400	50,600
Florida	1,250	.....	1,250	1,250
Illinois	223,000	.....	223,000	236,000
Indiana	32,600	.....	32,600	32,500
Kansas	†358,500	.....	358,500	†351,900
Kentucky	47,200	.....	47,200	50,400
Louisiana	940,000	76,250	1,016,250	1,016,150
North	130,000	3,000	133,000	132,900
South	810,000	73,250	883,250	883,250
Michigan	27,100	.....	27,100	28,300
Mississippi	109,200	4,950	114,150	114,150
Montana	72,950	.....	72,950	72,400
Nebraska	38,650	.....	38,650	38,650
Nevada	100	.....	100	100
New Mexico	262,600	5,275	267,875	268,375
North Dakota	30,750	.....	30,750	40,400
Oklahoma	†696,100	.....	696,100	†653,100
Texas	3,277,000	56,000	3,333,000	3,333,000
Dist. 1	57,000	550	57,550	57,550
Dist. 2	164,000	8,900	172,900	172,900
Dist. 3	459,000	26,300	485,300	485,300
Dist. 4	253,000	6,600	259,600	259,600
Dist. 5	44,000	475	44,475	44,475
Dist. 6	147,000	6,200	153,200	153,200
East Texas field	229,000	.....	229,000	229,000
Dist. 7-B	173,000	100	173,100	173,100
Dist. 7-C	176,000	4,300	180,300	180,300
Dist. 8	1,254,000	1,425	1,255,425	1,255,425
Dist. 9	216,000	850	216,850	216,850
Dist. 10	105,000	300	105,300	105,300
Utah	12,700	.....	12,700	10,900
Wyoming	298,250	.....	298,250	299,150
Others	‡100	.....	‡100	‡100
Total U. S.	7,674,650	142,825	**7,817,475**	7,789,875
Change from previous week, up			**27,600**	
Canada	†556,100	.....	†556,100	†557,000
Total U. S. production, January 1-March 23			618,892,300 bbl.	
Same period last year (crude plus cond.)			*599,597,800 bbl.	

*Includes 10,772,300 bbl. condensate. †Week ended previous Monday. ‡South Dakota.

CRUDE-OIL STOCKS



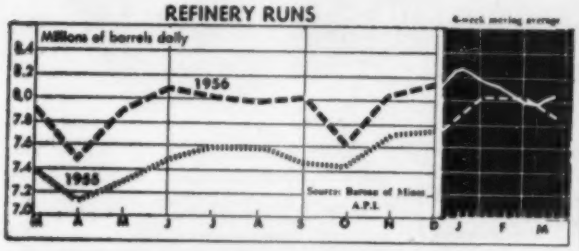
CRUDE-OIL STOCKS BY STATES OF ORIGIN*

(Thousands of barrels)

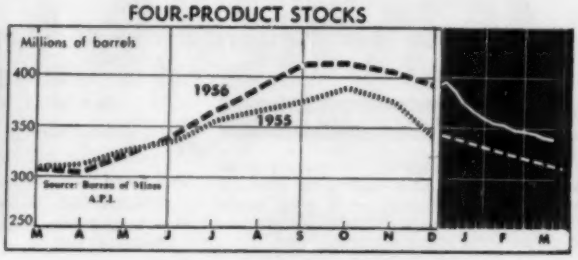
	3-16-57	3-9-57	3-17-56
Pennsylvania Grade	2,502	2,414	2,738
Other Appalachian	2,078	1,911	2,138
Illinois, Indiana, Michigan	9,479	9,586	9,264
Nebraska, North Dakota	1,951	1,865	2,186
Kansas	8,904	8,610	7,264
Oklahoma	21,485	21,410	23,325
Arkansas	2,424	2,418	2,646
Louisiana	18,310	19,626	15,415
North	2,902	2,816	2,396
South	15,408	16,810	13,019
Mississippi	2,140	2,121	2,902
New Mexico	7,362	7,233	7,539
Texas	113,556	113,884	121,803
East Texas proper	10,565	9,961	8,896
West Texas	52,932	53,791	60,217
Texas Gulf	21,520	21,172	22,878
Other Texas	28,539	28,690	29,812
Wyoming	16,994	16,724	15,707
Other Rocky Mountain	6,753	6,440	5,267
California	26,543	27,175	26,800
Foreign	†11,440	10,576	11,672
Total	251,921	251,993	256,666

*Bureau of Mines. †Includes 2,794,000 bbl. in California.

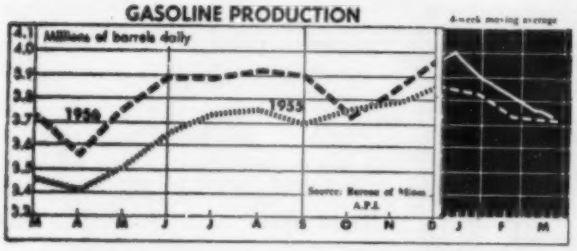
REFINERY RUNS



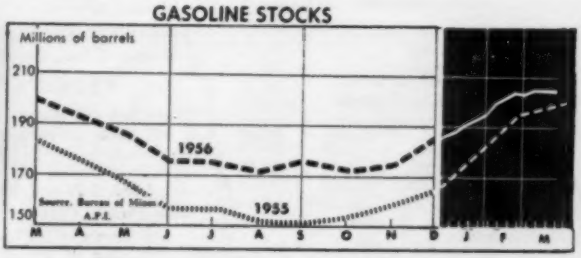
FOUR-PRODUCT STOCKS



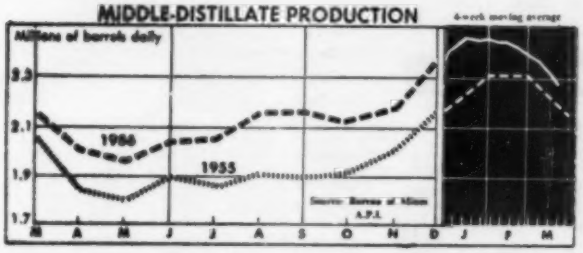
GASOLINE PRODUCTION



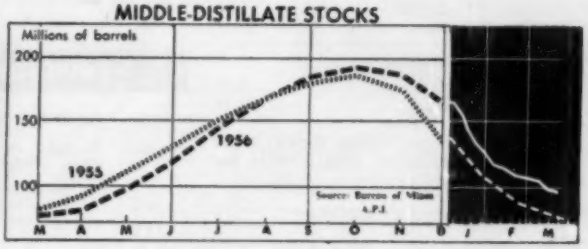
GASOLINE STOCKS



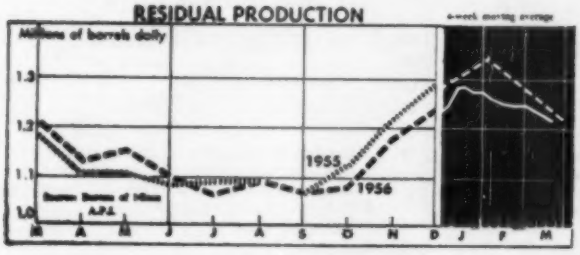
MIDDLE-DISTILLATE PRODUCTION



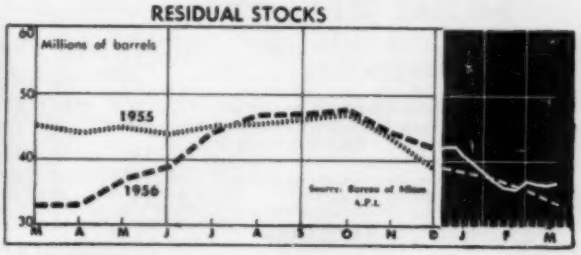
MIDDLE-DISTILLATE STOCKS



RESIDUAL PRODUCTION



RESIDUAL STOCKS



A.P.I. REFINERY REPORT, MARCH 22, 1957

(Thousands of barrels)

District—	Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.	Stocks‡—Gaso.†	Kero.	Dist.	Resid.	Bureau of Mines, March 1956—Daily avg. runs	Daily average production—Gaso.*	Kero.	Dist.	Resid.
East Coast	1,244	488.3	43.9	334.3	204.7	42,325	8,419	23,673	8,492	1,147	447.1	36.6	287.6	217.9
Appalachian:														
District 1	104	42.4	4.7	25.0	8.3	5,042	447	1,972	404	92	34.3	4.0	21.6	7.9
District 2	115	62.0	8.4	19.1	15.6	3,250	378	620	378	104	50.7	7.3	18.7	15.4
Ind., Ill., Ky.	1,420	670.4	78.2	291.6	191.6	37,002	3,744	12,116	4,638	1,394	704.1	74.5	287.3	184.9
Minn., Wis., Dak.	101	47.7	10.1	23.4	8.6	7,028	372	3,492	391	82	39.0	7.0	22.8	6.4
Okla., Kans., Mo.	684	370.7	16.7	157.4	38.3	21,466	762	7,317	875	666	372.5	18.4	159.4	35.3
Inland Texas	263	180.9	3.4	59.3	23.9	8,084	258	1,394	1,757	270	192.4	5.8	55.1	22.2
Texas Gulf Coast	1,892	821.3	82.6	539.3	212.4	28,177	2,797	9,113	5,296	1,983	902.3	113.5	529.9	251.3
La. Gulf Coast	646	282.3	55.4	162.7	49.4	12,117	1,409	4,629	1,517	713	344.6	58.7	173.2	52.9
N. La. and Ark.	100	38.3	5.6	21.3	7.0	5,168	794	1,731	209	71	24.1	4.3	17.3	3.2
Rocky Mountain:														
New Mexico	26	12.3	0.6	4.6	3.3	423	7	79	67	21	10.8	0.4	3.7	2.7
Other Rocky Mtn.	267	130.1	2.4	64.3	33.4	8,031	271	2,533	1,087	262	125.2	5.5	63.4	39.5
California	1,114	433.3	11.6	134.1	401.4	27,408	320	8,934	11,775	1,109	487.0	5.6	167.9	373.9
Mar. 22, 1957	7,976	3,580.0	323.6	1,836.4	1,197.9	205,521	19,978	77,603	36,886	7,914	3,734.1	341.6	1,807.9	1,213.5
Mar. 15, 1957	8,098	3,726.3	343.0	1,949.4	1,218.1	205,589	19,701	79,599	36,283	.....	.....	.....	.....	.....
Mar. 23, 1956	7,970	3,684.0	361.9	1,760.1	1,232.6	196,801	17,710	65,912	34,047	.....	.....	.....	.....	.....

*At refineries including natural blended. †Finished and unfinished. ‡At refineries, bulk terminals, in transit, and in pipelines.

Crude-Oil and Refinery Prices at Representative U. S. and Foreign Points

REFINED-PRODUCT PRICES

Following quotations are for refinery products in cents per gallon moving in interstate shipments on Wednesday each week unless otherwise noted. Crude-oil prices are per barrel at the wells unless otherwise listed.

GASOLINE*

Mid-Continent (Group 3):	
Regular (88 octane)	11.75-12.25
Premium (96 octane)	13.50-14.00
Gulf Coast (cargoes for coastwise or export movements):	
Regular (90 octane)	11.00-11.50
Regular (92 octane)	11.25-11.75
Premium (97 octane)	13.00-13.50
Premium (98 octane)	13.25-13.75
California (rack):	
Regular (84 octane)	13.1
Premium (93 octane)	14.1
Premium (96 octane)	15.1
Caribbean area (cargoes):	
Regular (87 octane)	11.00
Premium (93 octane)	11.75

*Quotations are for octanes shown. Prices usually vary with octane ratings within the regular, premium, and aviation grades.

NATURAL GASOLINE*

Group 3:	
Grade 26-70	4.5
Breckenridge:	
Grade 26-70	4.0

*If 26-70 natural is considered as 100 per cent, prices for lower-vapor-pressure grades increase 2.5 per cent for each unit drop in Reid vapor pressure down to and including 16-lb. Prices for grades below 16-lb. may vary slightly by areas or plants.

KEROSINE AND DISTILLATE

Mid-Continent (Group 3):	
Kerosine 42-44	10.00-10.375
Diesel oil (58 d.i. and above)	9.625-9.875
Distillate No. 1	9.625-9.875
Distillate No. 2	9.00-9.375
Gulf Coast (cargoes):	
Kerosine 41-43	10.50-11.00
Distillate No. 2	10.00-10.50
New York Harbor (barges):	
Kerosine 41-43	12.25
Distillate No. 2	11.65
Diesel fuel, 48-52 d.i.	11.95
Caribbean area (cargoes):	
Distillate No. 2	10.00

WAX (LB.)

Oklahoma (Group 3):	
132-135 A.m.p. (semi-refined) in tank cars	6.50
New York (export):	
126-130 A.m.p. crude scale (solid in bags or barrels	7.35

★Denotes change from previous week.

RESIDUAL FUEL (BBL.)

Mid-Continent (Group 3):	
Residual fuel (max. 1% S)	$2.35-2.45
Gulf Coast (cargoes):	
Bunker C fuel	$2.75-3.00
New York Harbor (barges):	
Bunker C fuel	$3.30-3.40
Caribbean (cargoes):	
Bunker C	$2.55
California (rack):	
Bunker C fuel, Los Angeles	$2.75-3.00

LUBRICATING OILS

Mid-Continent (Group 3):	
150-160 bright stock, solvent refined, 0-10 p.p., 95 v.i.	25.5
200 vis. neutral oil, solvent refined, 0-10 p.p., 95 v.i.	22.25
Pennsylvania Grade:	
145-155 vis. at 210, bright stock, 8 color, 25 p.t.	28
200 vis. neutral (180 at 100°), 25 p.t.	26

CRUDE-OIL PRICES

GRAVITY SCHEDULE

	Signal Hill, Calif.	Mid-Cont.*	Gulf Coast Tex.†	West Tex.‡ N.M.	Wyo. (sour)
14-14.9	$2.67	....	....	....	....
15-15.9	2.71	....	....	....	$1.89
16-16.9	2.74	....	....	....	1.94
17-17.9	2.78	....	....	....	1.99
18-18.9	2.82	....	....	....	2.04
19-19.9	2.85	....	....	....	2.09
20-20.9	2.89	$2.75	....	$2.62	2.14
21-21.9	2.93	2.77	....	2.64	2.19
22-22.9	2.97	2.79	....	2.66	2.24
23-23.9	3.01	2.81	$3.44	2.68	2.29
24-24.9	3.05	2.83	3.46	2.70	2.34
25-25.9	3.09	2.85	3.48	2.72	2.39
26-26.9	3.13	2.87	3.50	2.74	2.44
27-27.9	3.17	2.89	3.52	2.76	2.49
28-28.9	3.22	2.91	3.54	2.78	2.54
29-29.9	3.27	2.93	3.56	2.80	2.59
30-30.9	3.32	2.95	....	2.82	2.63
31-31.9	3.38	2.97	....	2.84	2.67
32-32.9	3.44	2.99	....	2.86	2.71
33-33.9	3.50	3.01	....	2.88	2.75
34-34.9	3.56	3.03	....	2.90	2.79
35-35.9	3.61	3.05	....	2.92	2.83
36-36.9	3.65	3.07	....	2.94	2.87
37-37.9	3.68	3.09	....	2.96	2.89
38-38.9	....	3.11	....	2.98	2.91
39-39.9	....	3.13	....	3.00	2.93
40 and up	....	3.15	....	3.02	2.95

*Includes Oklahoma, most of Kansas, North Dakota, West Texas (sweet) and North Central Texas. †Low Cold test Gulf Coast. ‡Sour.

Effective dates: California January 17, 1957, east of California, January 3-January 10, 1957; Pennsylvania Grade, January 16, 1957.

Some crudes in North Central Texas and West Central Texas, are on the intermediate schedules.

FLAT PRICES

Louisiana:	
Bienville (distillate)	$3.05
Ville Platte	3.45
Texas:	
East Texas	3.25
Conroe	3.53
Van	3.08
Pennsylvania Grade:	
Bradford	4.88
Middle District	4.70
Southwest Pennsylvania	4.41
West Virginia	4.23
Buckeye Grade	4.23
Zanesville Grade	3.27
Illinois Basin	**3.15**
Canada:	
Leduc-Woodbend (flat prices D-2, D-3)	2.78
Redwater (Alta.) D-3	2.67
Smiley-Viking (Sask.)	2.44
Pembina	2.65

FOREIGN

Venezuela:	
Cumarebo, 48°-49.9°, Tucupido	3.75
San Joaquin, 40°-40.9°, Puerto La Cruz	3.37
Oficina, 35°-35.9°, Puerto La Cruz	3.05
Tia Juana medium, 26.5°-26.9°, Amuay*	2.55
Quiriquire, 16.5°-16.9°, Caripito	2.45
Lagunillas heavy, flat, Amuay or Las Piedras*	2.38
Bachaquero, flat, Las Piedras*	2.23

Prices for all crudes of 24° or lighter vary 2 cents per degree change, up or down. All crudes heavier than 24° vary 2.5 cents per half-degree gravity change.

*Also available at La Salina at 3 cents per barrel less.

Middle East, Persian Gulf (cargoes, f.o.b. lifting port):	
Arabian, 36.0°-36.9°, Ras Tanura	$1.97
Iranian, 34.0°-34.9°, Bandar Mashur	1.91
Iranian, 34.0°-34.9°, Abadan	1.86
Iraq, 36.0°-36.9°, Fao	1.87
Kuwait, 31.0°-31.9°, Mina-al-Ahmadi	1.72
Qatar, 39.0°-39.9°, Umm Said	2.06
Middle East, E. Mediterranean:	
Arabian, 36.0°-36.9°, Sidon	2.69
Iraq, 36.0°-36.9°, Tripoli, Banias	2.69
Far East (cargoes, f.o.b. Lutong, Sarawak):	
Seria Light, 37°-38°	2.60

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(Latest reported spot fixtures)

★ Gulf-U.S.N.H., dirty (USMC+65%)	$4.70
★ N.W.I.-U.S.N.H., dirty (USMC+20%)	3.24
★ N.W.I.-U.K., clean (Scale+105%) (66s. 8d.)	9.30
★ Gulf-U.K., dirty (USMC+45%)	11.09
★ P.G.-Japan, dirty (USMC+60%)	14.40

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FOR SALE—One National T-20 Rotary Drilling Rig with 6 Cylinder G.M. Unit with C-150 B Pump complete with GMC twin diesel motors, 96' Lee C. Moore derrick, 4,000' new 4½" API Full Hole Grade "E" drill pipe, approximately 2500' used 4" drill pipe. Rig complete ready to drill. Price $75,000. Will finance to responsible person. Contact Clint Hogue, 609 Citizens Bank Building, Evansville, Ind.

FOR SALE—Used—10' x 40' 24,000 gal. horizontal steel riveted and welded gasolene storage tanks, three at Tallant, Oklahoma. $1,000.00 each, seven at Wichita gasolene plant, $650.00 each. Cities Service Oil—Patridge—Bartlesville.

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FOR SALE Two 7½ x 14½ x 18 inch Ideal Steam mud pumps. Good, ready for work. Both one steel skid. First $1,750 takes. Located Sinton, Texas. Contact Jack Simmons, General Supt. Al Buchanan Drilling. Phone EM 4-2381, Sinton.

PRICED TO SELL. Hydraulic pipe pulling unit, two speed 6' jacks, spiders, slips, arch bars, sill, breakout tongs, 4 cylinder displacement pump etc. All on '47 2-Ton Dodge Truck. All in good shape and ready to work. Phone S.H. 6-4016, J. E. Bedingfield. Box 563, Artesia, N. M.

SALES AND RENTALS. Used cable drilling and fishing tools, casing, production equipment; from the Southwest's largest stock of oil field supplies. Degen Pipe and Supply Co., Tulsa.

2—55,000 BARREL tanks 5 ring, plates 6' x 20' complete steel support, steel roof, swing lines, ladder, now being dismantled. Price $100 ton, loaded on cars Oklahoma City, Okla. Strictly guaranteed. P. O. Box 1858, W. C. Berry, Tulsa, Okla.

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C-34 WALKER-NEER Spudder, with or without 5-7 tools. A-1 condition. Fully equipped. Located at Drumright, Oklahoma. Box 788 or phone 20, Drumright.

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1—Wyatt 30" x 70' Stabilizer 160# 30 tray
1—8' x 96' tower, 40 tray, 135# WP.
1—3' x 50' tower, 34 trays.
1—Ethyl lead plant.
3—Upshot heaters, 10 mil. BTU/hr.
8—Welded storage tanks, 5,000, 2,000 bbl.
8—Hi-vol pumps, 10 x 7 x 18, 10 x 6 x 12, 6 x 4 x 12, 6 x 3 x 8.

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2—12' x 45' Butane Tanks, 125#
2—12' x 45' Storage Tanks, 25#
1—14' x 21' Clay Tower, 125#
1—8' x 75' Tower, 20 Trays, 25#
1—18" x 32' Tower, 15 Trays, 160#
2—8½' x 25' Tanks 50#

HOT-OIL PUMPS

3 Pacific ITB, 400 gpm—2,000' hd, 735 gpm—3,100' hd.
5 Pacific SVTB, 612 gpm—600' hd, 324 gpm—480' hd, 308 gpm—516' hd, 193 gpm—389' hd.
1 Pacific HVTB (unused) 1270 GPM—408' Hd.
8J hot oil pump 3 x 9, 13 st, 325 gpm, 4600' hd.

HEAT EXCHANGERS

3—Kellogg Adm. Ftg. Hd. 2200, 1800 Sq. Ft., 315#
4—Kellogg Stnl Ftg. Hed. 800, 650, 500 Sq. Ft.
18—GR Fin Tubes, 73 Sq. Ft.
6—Brown fintube exchangers, 300# 140 Sq. Ft. 4-6 chrome.
6—Adm. 785, 742, 425 Sq. Ft.
30—304 SS shell & tube condensers 100-1000 Sq. Ft.

COMPRESSORS

1 Worth LTC-6 800 hp.
3 Penn Comps 100 CFM 500 lbs.
385 CFM 160 lbs.

MISCELLANEOUS

6—Bird Centrifugals 32 x 50, 24 x 38, 18 x 28.
5—Sweetland Filters No. 12, No. 10, No. 7, No. 5.
4—Rotary Vac. Filters, 10 x 12, 8 x 10, 5 x 8.
Lab Petro-Chem furnace 50,000 BTU/hr.
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FOR SALE EQUIPMENT

20 FT. 5-INCH OD drill collars at a bargain price. Ask for Ralph Varel, FI-16487, Varel Mfg. Co., 9230 Denton Dr., Dallas.

FOR SALE

USED-EXCELLENT CONDITION

8' x 5' x 22' Covered Fuel Tank
8' x 8' x 16' Bath and Washhouse
7' x 30' x 7' Mud Tank
8' x 8' x 38' Mudhouse—Double Sliding Doors.
Engine substructure (4 sections)
All stored at Houston

Call CA—3-4491, Houston, Texas
ED PRICE.

Western Natural Gas Company
1006 Main Street Houston, Texas

FOR SALE EQUIPMENT

ONE MODEL R4 Wichtex Portable Rig, in excellent condition, 2680' practically new Drill pipe. Attractive price. Also, 3000' used Drill pipe, 90c per foot. Phone #740, Sullivan, Indiana.

FOR SALE: 600 tons Carnegie MP-115 42 ft. & Larssen Section II 30 ft. and 40 ft. lengths steel sheet piling located New Orleans and Tampa. Seaboard Steel Company, Tel. RIngling 7-0461, Sarasota, Florida.

VESSEL—New 40-tray ASME code vessel fabricated 1956. Never installed. A-285-C-FBQ Steel, 5'6" diameter and 87'0" tangent. Maximum working pressure 267 psi at 650° F. Available for immediate shipment. The Fluor Corporation, Ltd., P. O. Box 7030, East L. A. Branch, Los Angeles 22, California, c/o Mr. R. M. Savage. Phone: ANgelus 2-6111.

FOR SALE EQUIPMENT

DRILLING RIG, for immediate sale at sacrifice. Completely portable. Cardwell "S" draw works with Waukesha GKU engine and double pole telescoping 84' mast on tandem float. Gardner-Denver Pump with International engine and 60 barrel water tank mounted on 32' Lo Boy. International 185 and 210 tractors, together with float, water trailer and house trailer. Call James T. Daniel, Cleburne, Texas, 5-2409 or 5-6348.

OFFERING SUBJECT to prior sale F.O.B. our Eola, Louisiana yard the following unused pipe: 15,000 feet 6 inch Armco. 3,000 feet 8 inch Armco, 1,000 feet 12 inch Taylor, 5,000 feet 8 inch Reynolds Aluminum irrigation pipe. Also—1 Ethyl Tank Plant. Call LUther 4-5291, Tulsa, Okla. or write Anchor Gasoline Corporation, 714 Atlas Life Building, Tulsa.

LIQUIDATION 11,000 BBL. REFINERY

D-X SUNRAY OIL CO., ALLEN, OKLA.

We are now liquidating this modern refinery and can offer equipment at a fraction of its cost.

INCLUDED ARE: 6 Heaters with Chrome Tubes, Welded Towers from 2' to 8' with Operating Pressures up to 475 psi., Reboilers, Accumulators, Heat Exchangers, Hot Oil Pumps, Centrifugal and Steam Pumps, Boilers, Gas and Diesel Generator Sets, New Chrome Heater Tubes, Pipe, Valves, etc.

Your Inspection Is Invited. Write for Catalogue.

HEAT & POWER CO. Inc., 60 E. 42 St., New York 17, N. Y.
310 Thompson Bldg., Tulsa 3, Okla.

FOR SALE

A.P.I. LINE PIPE

60,000 TONS LARGE DIAMETER PIPE

20" thru 30". No brokers—end users only.

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THE INTERNATIONAL CORPORATION

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DALLAS, TEXAS
HAmilton 1-7123

LIQUIDATION TIDEWATER OIL COMPANY

Drumright, Okla., Modern 15,000 Bbl. / Day Refinery

presently being dismantled — Immediate removal and shipment — exceptional prices — your inspection invited — representatives on premises

COMPLETE UNITS

Houdriflow Catalytic CRACKING UNIT 8800 bbl./day. (new 1952)

Vacuum Crude Oil DISTILLATION UNIT 15,000 bbl./day (new 1953)

POLYMERIZATION UNIT 400 bbl./10#/day

ETHYL BLENDING PLANT 8500 gal. Complete SKIMMING POND

110,000 gal. FOAMITE SYSTEM—complete

VALVE TESTING UNIT Ing. Rand 41X5
TELEMATIC 48 TANK GAUGING SYSTEM

50,000#/hr. COCHRANE WATER TREATING and Deaerating Plant

2—28 Spot CAR LOADING RACKS, capable 10 products each spot

FURNACE TUBES

500—New Croloy #5, 3" to 6⅝" OD 15 to 32' long
500—4", 4-6% Chrome, headers
200—4½", 4-6% Chrome, headers
200—5", 4-6% Chrome, headers

VESSELS

8'x32'3" ACCUMULATOR, 135 PSI @ 650° F.
6'x40' SOAKER, 500 PSI @ 850° F.
20'x28'4" AGITATOR, cone bottom
10,000 bbl. HORTONSPHERE
6500 gal. PROPANE TANK

WELDED TOWERS

8'x34'6"x½" 10 trays
6'x30'x½" 9 trays
5'x58'x⅜" 26 trays
4'6"x30'5"x⅜" 14 trays

PUMPS

HOT OIL 334 GPM, 1,000 PSI (2)
FIRE 2500 GPM at 426' head
CENTRIFUGAL from 60 to 1500 gal. from 40 to 655' head.
STEAM—Hot Oil—Simplex—Duplex PROPORTIONING—1 to 5 HP

OTHER ITEMS

HEAT EXCHANGERS—196-3100 sq. ft. (25)
NEW STEEL STACKS—240'
53—STORAGE TANKS 1,000-100,000 bbl.
40—STORAGE TANKS 1,000-27,000 gal.
10 Ton OVERHEAD TRAVELING CRANE
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Write—Wire—Phone—for complete Information and Catalog

Heat and Power Co., Inc.

NEW YORK OFFICE—60 East 42 St., New York 17, N. Y., Murray Hill 7-5280
TULSA OFFICE—310 Thompson Bldg., Tulsa 3, Okla., Diamond 3-4890.
DRUMRIGHT OFFICE—P. O. Box 587, Drumright, Okla. Phone 569

FOR SALE EQUIPMENT

TWO UNUSUALLY FINE USED ROTARY RIGS

U-15 UNIT RIG WITH TWO PUMPS — DRILLED ONLY 123,300' OF HOLE

U-15 Draw Works with Automatic Catheads and Hydromatic Brake, powered by 3—NKU Waukesha Engines; 131' Lee C. Moore Mast with 9' High Substructure; HP-14000 Wheland 7½" x 14" 350 H.P. Main Pump driven from Compound; Stand-by Pump Unit with FXQ Gardner-Denver powered by LRZU Waukesha Engine; 10¾" Cameron QRC Blowout Preventer; Vibrating Shale Shaker; 3—Steel Mud Pits; 9700'—4½" J & L Blue Ribbon Drill Pipe with Hard-Banded Hughes Xtra Hole Tool Joints which has drilled only 16,000' of hole and 9—6¾" Drill Collars. (Located in Oklahoma).

H-400 IDECO SPLIT RIG WITH DEEP-HOLE PUMP — NEW 1954

H-400 Ideco Draw Works with Automatic Catheads, Hydromatic Brake and Two-Engine Compound, powered by 2—NKR Waukesha Engines; 126' Lee C. Moore High Speed Mast with 7' Substructure; Pump Unit with HP-14000 Wheland 7½" x 14" 350 H.P. Pump powered by LRZU Waukesha Engine; Vibrating Shale Shaker; 5700'—4½" J & L Blue Ribbon Drill Pipe recently Tuboscoped and re-sleeved with Hard Bands applied; 9—6½" Drill Collars. (Located in Oklahoma).

LUCEY PRODUCTS CORPORATION

OKLAHOMA CITY • DALLAS • SHREVEPORT • ODESSA
LOS ANGELES • HOUSTON • CALGARY

FOR SALE—Cardwell Spudder, RL502, complete with tools, equipment necessary for efficient operation. Price, inventory on request. K & A Drilling Co., Phone 448R, Box 497, Ellinwood, Kansas.

LINE PIPE, 10,000' 2⅛" OD, seamless. 20' randoms. Beveled. 22c. And 17,000' 2" OD, seamless, beveled 18c. Ideal for water (domestic use) air, oil, gas. Practical for construction, fences, etc. M. J. Regan Pipe Co., Coffeyville, Kans.

LINE PIPE, 4" standard 40' randoms. Clean inside and out. Beveled ready to lay 65c. Regan Pipe Co., Coffeyville, Kans.

PRICED TO SELL: Used 8" x 20" Gardner-Denver FH-FXL Power Slush Pumps. Details furnished upon request. Write Box K-109, The Oil and Gas Journal, Tulsa, Oklahoma.

FORD Industrial Engine. 112 H.P. Complete with Governors, Natural Gas Carburetor, Power Take-off Ratio 208-1. First Class Condition. Write P. O. Box 323, Muenster, Texas.

FOR SALE: Used Unit U-30 Drawworks complete, Mid-Continent Model 6240 Swinging Compound, and Four LRIG-600 Cummins Gas Engines with Series 16000 Twin Disc Torque Converters. Inquire Box K-110, The Oil and Gas Journal, Tulsa, Oklahoma.

GAS METERS FOR SALE: Foxboro and Westcott Orifice Meters, Large Stock of Late Types and in Good Condition. George Milner, Box 124, Okmulgee, Okla.

BESSEMER GAS COMPRESSORS—3 type 10 twins direct connected units—Boswell-Frates Company, 1003 Kennedy Building, Tulsa, Oklahoma.

3500' WILSON Super Rotary Rig with telescopic double mast complete with all equipment, including 3,000' of drill pipe. Excellent condition. Presently in operation. Box K-112, The Oil and Gas Journal, Tulsa, Oklahoma.

NEW BOILER TUBES: 5400' 2" OD x 14' seamless, 12 gauge. 30c. 8000' 2¼" OD x 20' to 22' seamless 12 gauge. 35c. M. J. Regan Pipe Co., Coffeyville, Kans.

EQUIPMENT WANTED

WANT 2600' good used 3½ drill pipe—5 good 5½ drill collars—payment on per well basis. Box 21, Falls City, Nebr. Phone 3646.

WILL BUY used set of 24 trace seismic instruments; truck mounted. Must be in good operating condition. Century Instruments preferred. Also interested in shooting truck and survey equipment. Box J-995, The Oil and Gas Journal, Tulsa, Oklahoma.

NEW GAS COMPRESSOR AVAILABLE FOR SALE

Electrically operated, of the following specifications:

Chicago Pneumatic Simplate Valve Gas Compressor, Serial No. 55045.
Size 12—12 x 7 Y D E
Direct connected to Allis-Chalmers Induction Motor NENA
Design Type AZZ—24 hrs., 150 H.P., 4,000 Volt, 3 phase, 60 cycle, 585 R.P.M.
Serial Number 1-5128-71064-1-1, 55° C rise.

Offers should be directed to the

SCRANTON SPRING BROOK WATER SERVICE COMPANY
20 North Franklin Street
Wilkes-Barre, Pa.

Unit can be inspected at the Generating Plant of the
SUNBURY GAS WORKS, Sunbury, Pa.

WANTED TO BUY

Shut Down Oil Refineries—
Chemical Plants—Gasoline Plants—
Tank Farms—Pipe Lines, etc.

Specialists in liquidation of oil properties for over 25 years. We have worked with most major Oil Companies in the United States. Will purchase for cash.

Brown-Strauss Corp.
HARRY B. STRAUSS
1546 Guinotte Kansas City, Mo.
Telephone HA 1-1000

HELP WANTED

FOREIGN EMPLOYMENT. List oil companies, drilling contractors, seismograph contractors, showing where apply foreign jobs. $5.00 cash. OIML Co., Box 2603, Tulsa, Okla.

ESTABLISHED independent oil company desiring to expand engineering department has opportunity for qualified graduate engineer with approximately two years Gulf Coast experience in completions and workovers. Initial replies should include a resume of experience and qualifications. Box J-980, The Oil and Gas Journal, Tulsa, Oklahoma.

ENGINEERS—Chemical, Mechanical, Petroleum or Gas Engineering graduates. Major Oil Company will interview applicants for openings in natural gas department. Their area of operations consists of Mid-Continent, Louisiana and Gulf Coast. Salary to suit previous experience. Our employees are aware of this ad. Box K-101, The Oil and Gas Journal, Tulsa, Oklahoma.

OPERATING ENGINEER
For Writing Operating Manuals

To compose operating instructions for petroleum refinery, chemical and petrochemical plants. Will also assist in activities of New York Operating Department.

Graduate Chemical or Menchanical Engineer with minimum 5 years experience in performing similar work with petroleum refiner or contractor. This is a challenging position with an excellent opportunity for growth.

Please airmail in confidence complete chronological resume, including education and employment, salary history and salary requirements, to Personnel Department

HYDROCARBON RESEARCH, INC.
115 Broadway New York 6, N. Y.

LIVE AND WORK IN THE LAND OF 10,000 LAKES

Our Expanding Independent Refinery, located in a Twin Cities suburban area has openings for

CHEMICAL ENGINEERS
MECHANICAL ENGINEERS

These positions offer challenging assignments and unusual opportunities for professional development in a medium sized, growing company. Excellent salaries, many employee benefits. Good living conditions, excellent schools and unsurpassed recreational facilities.

CALL OR WRITE
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Personnel Manager
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Tel. GLenview 9-5771

HELP WANTED

GULF OIL CORPORATION
— ENGINEERS —

PETROLEUM
GAS
DRILLING
RESERVOIR
MECHANICAL
PIPE LINE

Subsidiary operating in Venezuela has opportunities for engineers with/without experience. Salary commensurate with experience.

P. O. BOX #35
Bowling Green Station, New York 4, New York

HELP WANTED

Operators For Oil Refinery Expansion

COMMONWEALTH OIL REFINING COMPANY, INC.

Completing expansion to 60,000 B/D, new refinery near PONCE, PUERTO RICO Minimum experience required: Three years, preferably on Houdriflow, Cat Cracking, Cat Reforming, Cat Poly, Gas Recovery, SO_2 Treating Units. Write, giving work experience, qualifications, units operated to:

Commonwealth Oil Refining Company, Inc.
P. O. Box 1406
Ponce, Puerto Rico

HELP WANTED

LANDMAN

Independent Oil Company has opening for Landman with ability to assemble deals and make trades. Geological background preferred. Must have experience and knowledge of Mid-Continent area; Four Corners experience desirable. Age limit 40. Excellent paying position. Reply giving past employment, education, and qualifications. All replies confidential. Reply

BOX K-108, THE OIL AND GAS JOURNAL, TULSA, OKLAHOMA.

HELP WANTED

SURFACE GEOLOGISTS

(Ages 24 - 38)

Current employment opportunities with a major integrated United States oil company in South America. Openings now exist in an expanding Geological organization at levels requiring from 3 to 8 years of field party experience. Salary, including bonus, from $14,000 to $17,750. Liberal employee benefits and home vacations with travel expenses. Interested experienced Surface Geologists with B.S., M.S., or Ph.D. degrees in Geology are invited to send complete resumes to the address given below. Interviews will be arranged for qualified candidates. All replies strictly confidential.

P. O. BOX 480

NEW YORK 19, NEW YORK

DEPT. A-21

Petroleum Geologist

Established Oil Company desires Geologist for employment in West Texas area. Must know area and have three to six years of active experience in subsurface mapping and interpretation. Excellent opportunity for advancement. Salary will be commensurate with ability and experience. Reply should state age, education, experience, and salary desired.

BOX J-356,
THE OIL AND GAS JOURNAL,
TULSA, OKLAHOMA.

REFINERY SUPERINTENDENT

Opportunity for Present Process Engineer

Independent refiner with modern plant and excellent growth prospects needs refinery superintendent. Will report to refinery manager and supervise all operations and maintenance. Definitely interested in mature chemical engineer with several years process engineering experience in modern rfinery who has the necessary personality, judgment and energy to step directly into high level refinery supervision. Previous supervisory experience desirable but by no means essential for the right man. North Central States location with excellent living conditions.

For consideration, send resume to:
FRED P. LOBBAN
GEORGE ARMISTEAD and COMPANY
1200—18th Street, N. W.—
Washington 6, D. C.
NO FEE

BECHTEL

SAN FRANCISCO, CALIFORNIA

Offers engineers liberal relocation allowances from the point of employment to the engineering office in San Francisco. These allowances include transportation for you and your family plus moving allowances for your household furnishings.

PIPELINE ENGINEERS

SENIOR ELECTRICAL
SENIOR MECHANICAL

San Francisco opportunity for senior electrical or mechanical engineers with experience on oil pipeline and pumping stations or gas pipeline and compressor stations.

Send resume to Manager of Employment & Placement
Industrial Relations Division

BECHTEL CORPORATION

Engineers and Builders for Industry
220 Bush Street, San Francisco 4, California

SOUTH AMERICA

• Career employment with Major American Oil Companies • Salaries Open • Cost of Living Allowance • Monthly Bonus.

NO U. S. INCOME TAX
OUR FEE AND TRANSPORTATION PAID
Maximum Age to 40

- Engineers, All types—Degree required. Exp. or inexperienced.
- GEOPHYSICIST, Degree—3 to 5 yrs. Exp.
- GEOLOGIST, Degree—Age to 32—Single.
- TOOLPUSHERS, 3 to 5 yrs. experience.
- MECHANIC GAS, 5 yrs. experience.
- MECHANIC DIESEL, 4 yrs. experience.
- FOREMAN CONNECTION, 3 yrs. experience.
- FOREMAN ELECTRICAL, 3 yrs. experience.
- SUPERVISOR, OIL HANDLING, 3 yrs. exp.
- MUD TECHNICIAN, 1 yr. exp. Age to 32.
- CLERICAL, Male and Female, Oil exp. Age to 32. Must be single.

All information confidential.
Send complete resume to:
OVERSEAS EMPLOYMENT SECTION

CHAS. J. LOVELESS PERSONNEL SERVICE
616 S. Main • Tulsa, Okla. • GI 7-3193

PROCESS ENGINEER. Modern, growing plant in Gulf South has opening for Process Engineer experienced in catalytic reforming, petrochemicals and economic studies. Furnish record of education, experience, and salary requirements. Write Box J-983, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER with Master's Degree, or Doctor's in Chemical, Mechanical, or Petroleum Engineering for research and teaching in Petroleum Production Engineering at rapidly growing southwestern institution. Rank and salary open, twelve months employment possible, consulting work encouraged and available in immediate area. Applications will be kept confidential. Box J-902, The Oil and Gas Journal, Tulsa, Oklahoma.

Operations Engineer

Independent oil company has opening for petroleum engineer with four to seven years experience both technical and administrative for responsible position in planning and control. Knowledge of operating procedures, some valuation work and practical oil and gas law would be desirable. Excellent growth opportunities. Please furnish complete details on qualifications, including starting salary required.

Box J-987,
The Oil and Gas Journal,
Tulsa, Oklahoma.

CHEMICAL ENGINEER

Background preferably in petroleum refining process and operation for important work with international consulting engineering firm. Position involves work with oil, chemical, and related companies, mainly at management level. Requires knowledge of methods, equipment, investments, and economics, accompanied by mature sound judgment and agreeable personality.

Extraordinary opportunity for individual recognition and development with wide contacts in industry. Location in attractive area on Atlantic Coast. Salary commensurate with ability.

Box K-113,
The Oil and Gas Journal,
Tulsa, Oklahoma

GEOPHYSICISTS

(Ages 26 - 36)

Current employment opportunities with a major integrated United States oil company in South America. We now have openings in our expanding Geological organization for Seismic Interpreters with from 4 to 8 years experience. Salary, depending upon experience and including bonus, from $15,750 to $17,750. Liberal employee benefits and home vacations with travel expenses. Interested experienced Geophysicists with B.S., M.S., or Ph.D. degrees are invited to send complete resumes to the address given below. Interviews will be arranged for qualified candidates. All replies strictly confidential.

P. O. BOX 480

DEPT. A-21

NEW YORK 19, NEW YORK

PETROLEUM ENGINEERS

for Reservoir & Production engineering in varied types active fields in COLOMBIA, SOUTH AMERICA. Excellent salary, allowances, opportunity obtain additional experience & advancement. Minimum 2 years exp.

Forward Personal data, college transcript, to:

C. L. LAUE
Colombian Petroleum Co.
375 Lexington Ave., New York 17, N. Y.

CHEMICAL ENGINEERS

New staff positions, created by company expansion, are open for chemical engineers with up to ten years experience in refining or petrochemicals technical service, process control, economics or process design.

Write, giving resume, to

PONTIAC REFINING CORP.
P. O. BOX 1581
CORPUS CHRISTI, TEXAS

PRODUCTION ENGINEER—3-5 years experience for large independent company. Excellent benefits. Located in Kansas. Box K-105, The Oil and Gas Journal, Tulsa, Oklahoma.

PROCESS ENGINEER with two to five years' experience in refinery process work to fill position in newly organized Refining Division Technical Section. Work is of broad nature covering selection of processing steps and economic evaluation of processes. Unusual opportunity for advancement. Will pay moving and transportation expense. Liberal retirement, savings, insurance and health plans. Location—Bartlesville, Oklahoma. Replies will be held in confidence. Send resume of experience and salary requirement to Industrial Relations Division, Cities Service Oil Company, Bartlesville, Oklahoma.

PALEONTOLOGISTS

(Ages 30 - 38)

Current employment opportunities with a major integrated United States oil company in South America. An opening now exists in an expanding Geological organization for an experienced Senior Paleontologist with proven supervisory ability and know-how to run commercial laboratory. Salary, including bonus, $18,500. Liberal employee benefits and home vacations with travel expenses. Interested experienced Paleontologists with B.S., M.S., or Ph.D. degrees are invited to send complete resumes to the address given below. Interviews will be arranged for qualified candidates. Replies strictly confidential.

P. O. BOX 480

DEPT. A-21

NEW YORK 19, NEW YORK

Micro-Paleontologist and Stratigrapher

Require 6 to 10 years experience plus ability to conduct regional geological studies and to speak Spanish.

Field Geologist

Require 4 to 6 years experience in surface geology and field mapping. Ability to speak Spanish is essential.

Both positions are with a small independent oil company operating in South America. Excellent living conditions. Send full particulars on education and experience, with references to:

James L. Carlton, Jr.
P. O. Box 455
Casper, Wyoming.

HELP WANTED

PETROLEUM ENGINEER—Aggressive independent oil and gas company has opening for Petroleum Engineer for reserve evaluation. Unusual opportunity for qualified man. Experience desirable but not essential. Furnish resume of experience and education. All replies confidential. Corpus Christi Area. Box J-999, The Oil and Gas Journal, Tulsa, Oklahoma.

SITUATIONS WANTED

PRODUCTION SUPERINTENDENT; extensive experience both domestic and foreign. Age 45, available now. Box J-997, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING SUPERINTENDENT; 25 years experience in all drilling problems, worked in U. S., Canada, South America, Middle East. Box J-998, The Oil and Gas Journal, Tulsa, Oklahoma.

DISTRICT GEOLOGIST: Age 30, veteran, married, B.S. degree, experienced in West and West Central Texas, Southeast New Mexico, some in Canada and Gulf Coast, desires position with aggressive small company or independent in Texas. Excellent references. Box K-100, The Oil and Gas Journal, Tulsa, Oklahoma.

PETROLEUM ENGINEER, Secondary Recovery: Six-years supervisory experience; 3-years field, 3-years office. B.S. degree. Age 31, presently employed. Box J-989, The Oil and Gas Journal, Tulsa, Oklahoma.

GRADUATE PRODUCTION ENGINEER. Desires responsible position with aggressive independent or small oil company. 10 years intensive and varied production engineering experience with major company in Permian Basin. Married, 36 years old, employed. Box J-991, The Oil and Gas Journal, Tulsa, Oklahoma.

CHEMICAL ENGINEER: Fifteen years experience process design, economics, project planning and coordination in petroleum and petrochemicals, desires responsible engineering position or technical sales requiring process background. Box K-111, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGICAL ENGINEER: 10 years diversified experience in Production, Exploration, Drilling, and Land Operations in Mid-Continent Area. Desire affiliation with aggressive Producer, domestic or foreign. Box K-103, The Oil and Gas Journal, Tulsa, Oklahoma.

GEOLOGIST—Eight years major company experience in West Central and West Texas desires responsible position with progressive company or independent. Box K-104, The Oil and Gas Journal, Tulsa, Oklahoma.

DRILLING SUPERINTENDENT with administrative experience. Employed 20 years in Mexico and South America. Capable of assuming entire responsibility of drilling operations. Desires foreign employment. Box K-106, The Oil and Gas Journal, Tulsa, Oklahoma.

MAP CABINETS

END MAP-FILING WORRIES FOREVER! Kraftbilt Rollfiles keep rolled maps safe from dust, dampness, pilferers. Used by all major and hundreds of smaller oil companies. Send for new Catalog 1156-B. Ross-Martin Co., P. O. Box 800-A, Tulsa 1, Okla.

BUSINESS OPPORTUNITIES

WE NEED INVESTORS to Assist in Developing 10,000 Acres Choice Oil and Gas Leases, Good Geology Report, Extreme Arbuckle High. Write Saline Basin Petroleum Company; Salina, Kansas.

FINANCIAL CONTACTS. Underwriters, Brokers, Private Finders of Capital reached. No shopping. Confidential. FREE ENTERPRISE ASSOCIATES, 817 51st St., Brooklyn, N. Y.

Well organized, well established oilwell drilling contractor desires the management and supervision of oil properties in West Texas, Central Texas, and New Mexico. Can provide complete handling of oil properties from acquisition to production. No properties too small, none too large to handle. Inquiries from independents, groups, small or medium sized oil companies invited. Write, wire or call collect for further information.

MAKIN DRILLING COMPANY
P. O. Box 1828
Hobbs, New Mexico
Phone: EXpress 3-3141

PRODUCTION FOR SALE

325 A. OIL LEASE. 27 Producing Wells, 450' Peru Sand, 12 wells 3 years old, drilled in pattern, new equipment in wells, casing cemented, 2 gas compressors running recycling gas in sand, forced to sell account of poor health. Tel. 2708, Louisburg, Kansas. No correspondence. Glenn Seaborn.

FOR SALE: White Co., Ill. 1 Producing well; 1 well to be completed. $12,000.00. Also small waterflood, Hancock Co., Ky. 2 Producing wells. 2 Inputs. $6,000.00. Address Advertiser, 500 S. St. James, Evansville, Ind. or Phone GReenleaf 7-0092.

PRODUCTION WANTED

WANTED FOR CASH—Depleted and Marginal Wells for Salvage. Frank J. Black, P. O. Box 150, Phone 107, McPherson, Kansas.

WANTED: Oil production 100 bbls. and up, any size, prefer Okla., N. M., Tex., Colo. or Kan. B. Thurston, 1427 Princeton NE, Albuquerque, N. M.

WANT TO BUY—Oil Properties, settled or semi-settled production. 100 to 5,000 barrels daily in Oklahoma and Kansas. Contact Morris Sitrin, 1215 First National Building, Tulsa, Oklahoma.

BUSINESS SERVICE

Delaware Corporations formed and serviced. American Guaranty & Trust Company, P. O. Box 487, Wilmington, Delaware.

ROYALTIES

OFFERING CHOICE ROYALTIES. You can now make very small investments on income Royalties or those ahead of drilling. A. S. Berry, 520 Wright Bldg., Tulsa, Okla.

LEASE AND DRILLING BLOCKS

NEED CAPITAL to prove 160 acre lease in Creek County, Okla. Will sell half interest. Will drill thru Prue and Red Fork sands to Bartlesville sand. Frank Root, Rt. 2, Box 113, Bristow, Okla.

BARTLESVILLE AND ARBUCKLE production for sale: Eight wells, 480 acres, proven locations to drill. Excellent water flood possibilities; lots of gas. Montgomery County, Kansas; telephone 436M, Independence, Kansas.

OIL, GAS AND MINERAL LEASES available in Dell City area of Hudspeth County, Texas. U. S. Geological Survey Map shows anticlinal axis nearby favorable for oil-gas structure. Am fee landowner of over 2000 acres. Write quickly to: Jefferson G. Smith, 215 Littlefield Building, Austin 15, Texas.

OIL LEASES IN BOOMING
4-Corners Area. November Indian Lease sale brought 30 Million Dollars. Some leases sold for $3,200 per acre. Wells estimated up to 1500 barrels of oil per day. Oil Leases from $2.25 an acre. Fortunes being made. Write for free information now.

ATLAS OIL SURVEY
Dept. OJ-4, Colorado Bldg.
Denver 2, Colo.

CHAVES COUNTY, N. M.
MAJOR OIL STRUCTURE
MAJOR CO. BLK.: Well to drill PENN, DEVONIAN & ELLENBURGER OIL ZONES. Subsurface & Base Map Indicate Major Field. Royalty & Close In Interests. Data on request to those who Value Great Potential.
W. J. PETERMAN, Geologist
Exploration 1918-1957 Engineering
PORTALES NEW MEXICO

Oil and Gas Mineral Leases For Sale:

Producing oil company wishes to dispose of non-producing leases.

1. 80 acres, Creek County, Oklahoma, primary term expires 1964, next rental date June 1957.
2. 1532 acres, Medina County, Texas, primary term expires 1959, next rental date September 1957.

Batex Oil Company
207 GULF STATES BUILDING
DALLAS, TEXAS

SERVICES

MARKET DEVELOPMENT - TECHNICAL Sales—licensed chemical engineer; full or part time in petroleum products, petrochemicals, additives of all types, asphalts, lubricants. Box K-107, The Oil and Gas Journal, Tulsa, Oklahoma.

DIRECTORY OF Oil-Industry Personnel, Venezuela and Colombia, 90 pages, just out. Airmailed $10 (please remit with order). VOSA, Apartado 3963, Caracas, Venezuela.

WANTED

MANUFACTURER'S AGENT to represent established manufacturer of Portable Rig Shelters. Prefer agent in Houston with men in New Orleans and Corpus Christi area. Individual representatives in each of the three Gulf Coast areas considered. Reply Box K-102, The Oil and Gas Journal, Tulsa, Oklahoma.

REAL ESTATE

BEAUTIFUL thirty-acre Estate, northern Minnesota. Fifteen hundred feet lakeshore includes point. Caretakers two bedroom house, guest cottage, 5 car garage, boathouse, large outdoor barbecue, excellent fishing, airport nearby, many extras. Box 2392, Tulsa, Okla.

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LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Land Office, Cheyenne, Wyoming. Notice is hereby given that approximately 2327.93 acres of land in 17 parcels within the known geologic structures of the Fourbear and Little Buffalo Basin fields, Wyoming, will be offered for oil and gas leasing through competitive bidding to the qualified bidder of the highest cash amount per acre through sealed bids on or before May 8, 1957, when bids will be opened. Details of the lease offering, and how and where to submit bids, may be obtained from the Land Office, Cheyenne, Wyoming. Arvin H. Olswold, Acting Manager.

LEGAL

SEALED BIDS will be received until 2:00 P.M., Mountain Standard Time, April 23, 1957, and opened at that time in the Office of the Uintah and Ouray Indian Agency, Fort Duchesne, Utah, for the leasing of 640 acres more or less, of Allotted Indian lands in thirteen separate parcels, located in Sections 22, 23, 26, and 27, Township 1 South, Range 1 West, Uintah Special Base and Meridian, Uintah and Duchesne Counties, Utah, for oil and gas mining purposes. The details of the lease offering and filing of bids may be obtained by addressing an inquiry to Superintendent, Uintah and Ouray Agency, Fort Duchesne, Utah, or to the Regional Oil and Gas Supervisor, U. S. Geological Survey, Casper, Wyoming.

LEGAL

SEALED BIDS will be received until 10:00 A.M. Mountain Standard Time, and opened at that time in the office of the Navajo Indian Agency, Window Rock, Arizona, on the following tracts of Navajo allotted lands on the dates as indicated as follows:

	Bids to be Opened
GROUP 1:	
Tract Nos. 1 to 210 inclusive	4-25-57
GROUP 2:	
Tract Nos. 211 to 399 inclusive	5-16-57
GROUP 3:	
Tract Nos. 400 to 564 inclusive	6-6-57

The details of the lease offering and how and where to file bids may be obtained by addressing the inquiry to the General Superintendent of the Navajo Indian Agency, Attention: Branch of Realty, Window Rock, Arizona.

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Allis Co., The Louis 48
Aluminum Co. of America 47
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American Manufacturing Co. of Texas 7
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Pipeline Patrol

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Contractor: Will do own work.

Cia. Shell de Venezuela.

Project: 177 miles of 20-in. from La Paz field in the Maracaibo district, to the Cardon refinery on Paraguana Peninsula, to fuel refinery furnaces.

Status: Under way.

Contractor: **Williams Brothers Co.**

Completion: 1957.

• **Empresa Nacional Del Petroleo.**

Project: 80 miles of 10-in. from Concon to Santiago, Chile.

Status: Planned.

Gaz de France

Project: 550 miles of 16 to 24-in. from Lacq field, southwestern France, to Paris, plus a 10-in. lateral to Nantes and 12 to 16-in. laterals to Lyons, making a 1,000-mile system.

Status: Right-of-way work under way.

Contractor: Being handled by French contractors.

Completion: First stage in 1958; complete system in 1960.

Petroleos Mexicanos

Project: 130 miles of 22-in. to parallel a 14-in. line from Reynosa to Monterrey in northern Mexico.

Status: Planned.

Sui Gas Transmission Co.

Project: 217 miles of 16-in. from Sui gas field to Moultan, Pakistan.

Status: Under way; to be extended later to Lahore with branches at Kot Addu, Jhang, Magiana, and Montgomery.

Contractors: **Pakistan Constructors,** a joint company of **Morrison-Knudsen** of Boise, Idaho, and **William Press, Ltd.,** of London.

Project: 145-mile line from Sylhet to Dacca, East Pakistan.

Status: Under consideration. If approved construction could start December 1958.

Technical Office of Hydrocarbon, Ministry of Mines and Petroleum, Government of Venezuela.

Project: 207 miles of 26-in. from Anaco fields to Caracas.

Status: Under way.

Contractor: **Fulghum Contracting Corp.** will be consultants; **Petrogas, S. A.** will engineer and construct the line.

Completion: Spring 1959.

• **Yacimientos Petroliferos Fiscales (Argentina)**

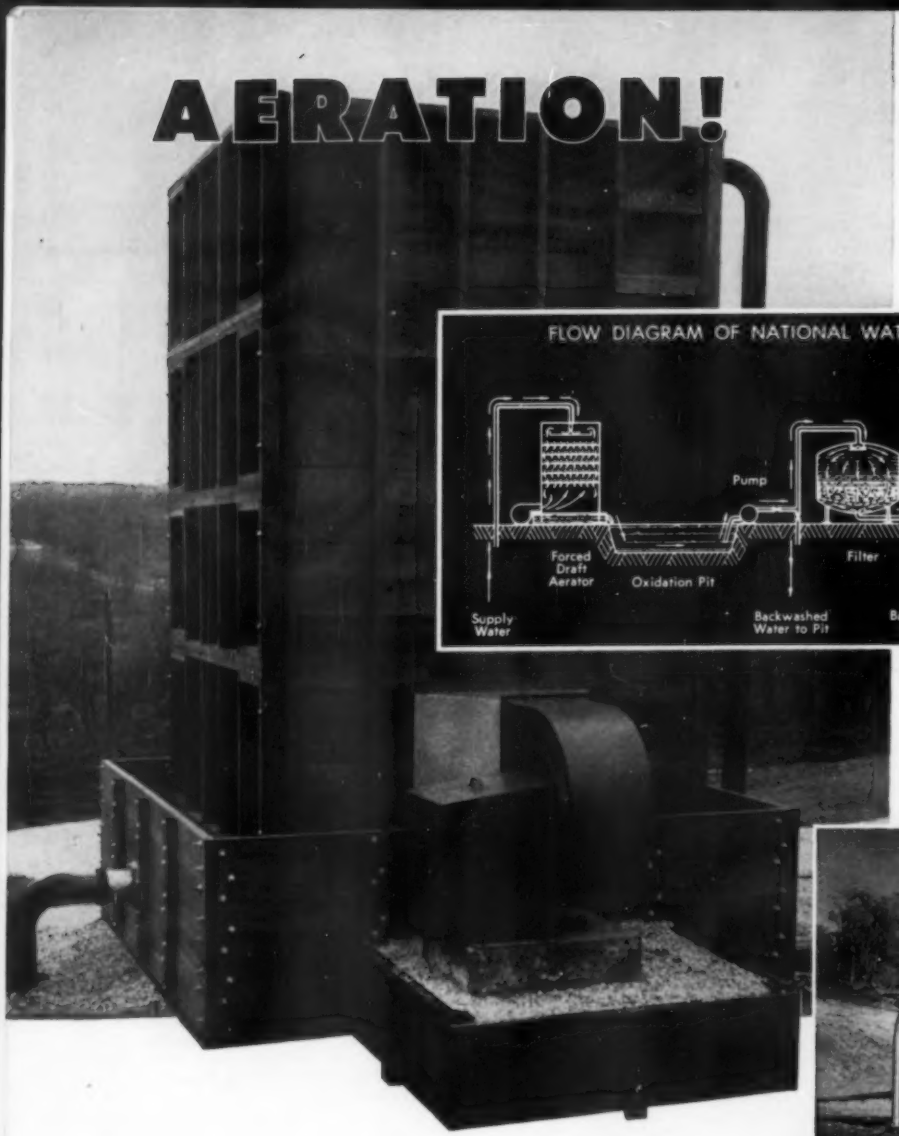
Project: 1,056 miles from Campo Duran to Buenos Aires.

Status: Proposed. Bids will be taken beginning the end of January 1957.

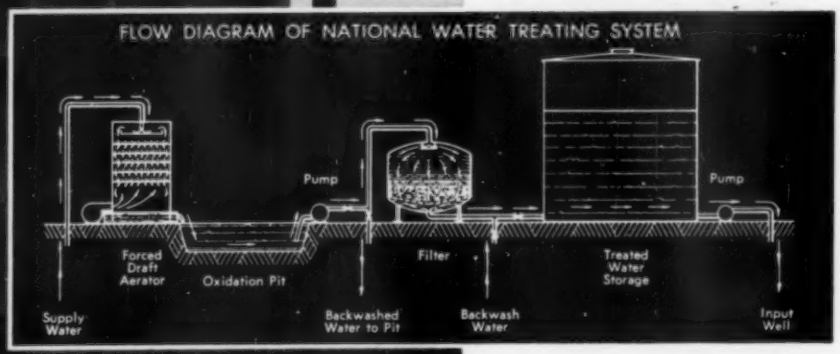
LEGAL

U. S. DEPARTMENT OF THE INTERIOR, Bureau of Land Management, Washington 25, D. C. Notice is hereby given that two separate parcels of land, comprising 40 acres within the known geologic structure of the Cranberry Lake Field, and 2.18 acres within the known geologic structure of the Winterfield Field, Michigan, will be offered for oil and gas leasing through competitive bidding to the qualified bidders of the highest cash amounts per acre at 1:00 P.M., E.S.T. April 10, 1957 when bids will be opened. Details of the lease offering, description of the lands, how and where to submit bids, and bid forms may be obtained from the Acting Manager, Eastern States Land Office, Bureau of Land Management, Washington 25, D. C., H. K. Scholl, Acting Manager.

AERATION!



National Aerator for treating supply water or disposal water in open water system.



Two National Aerators in series with water supply well located north of Tulsa, Oklahoma.

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Salt Water Treating

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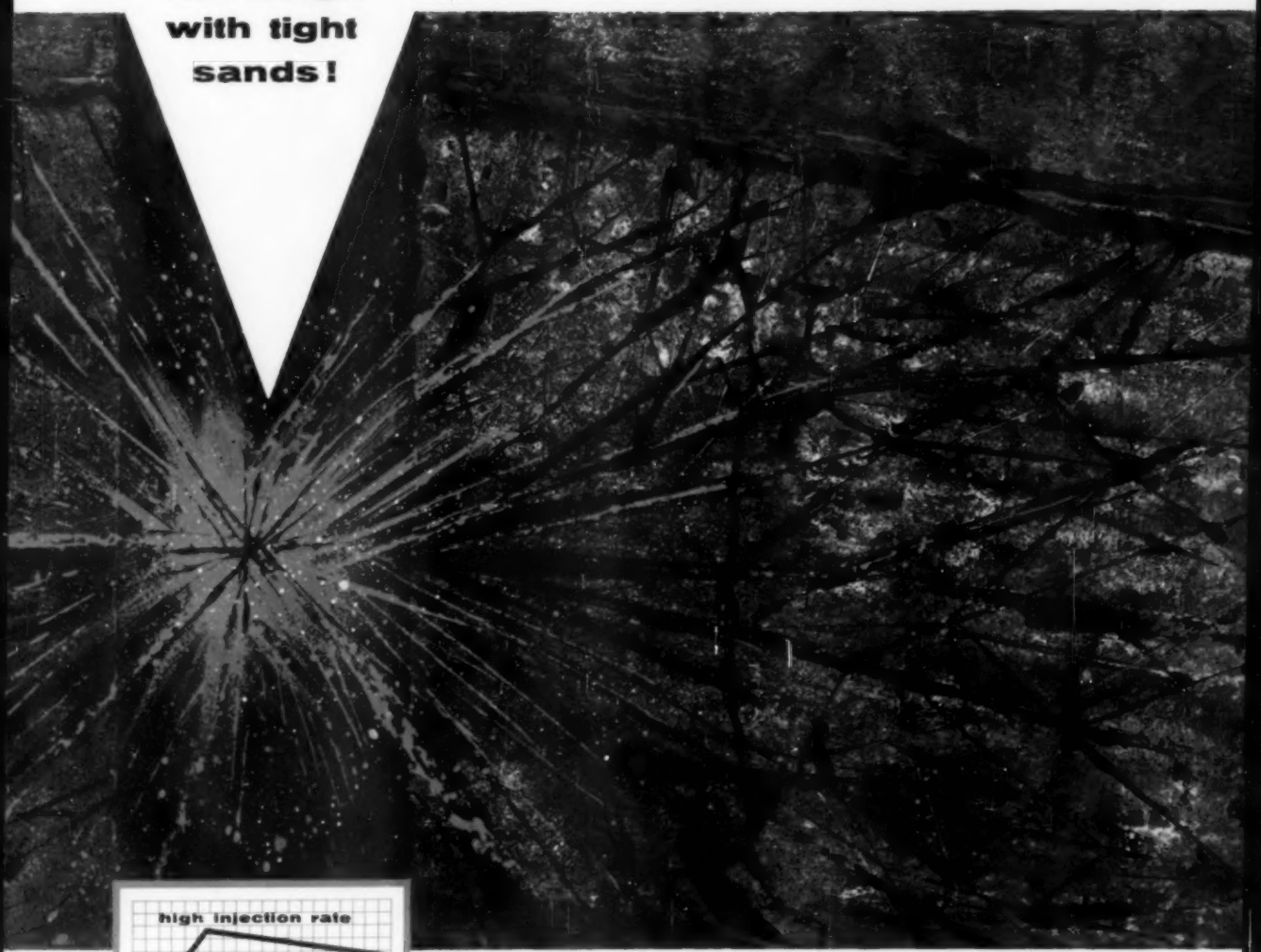

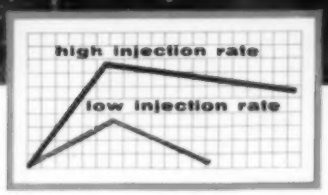

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Dowell knows how to get tough with tight sands, and has the equipment needed to do it. Exclusive with Dowell is the new high-injection-rate "Frac Team": 1) the mighty Allison Pumper with power to spare, 2) the Remote Panel for safer operation, and 3) the Dowell Blender for precise control of sand and fluid mixing.

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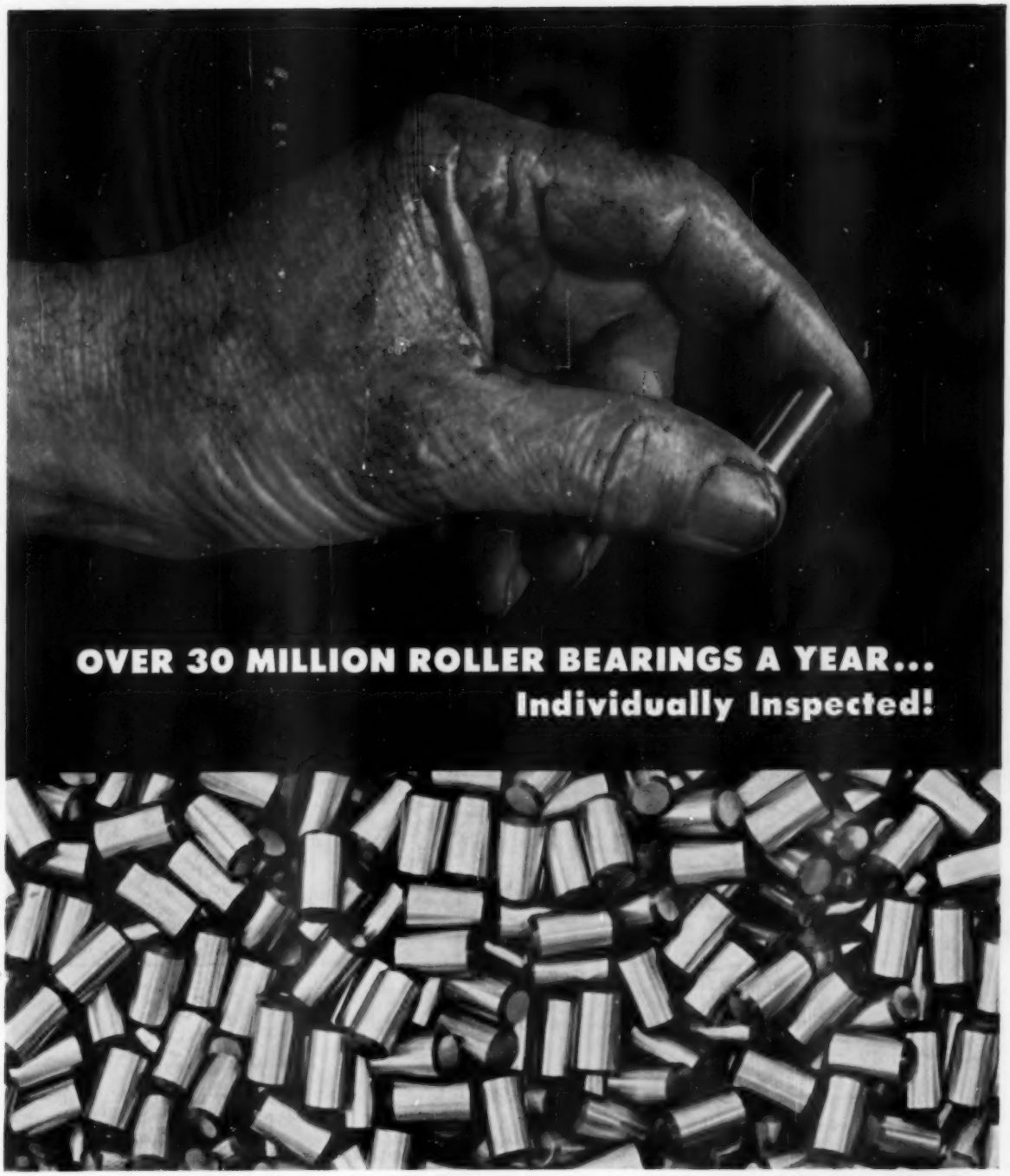

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